

# CHADBOURNE DIVERSION, FWP #12-17

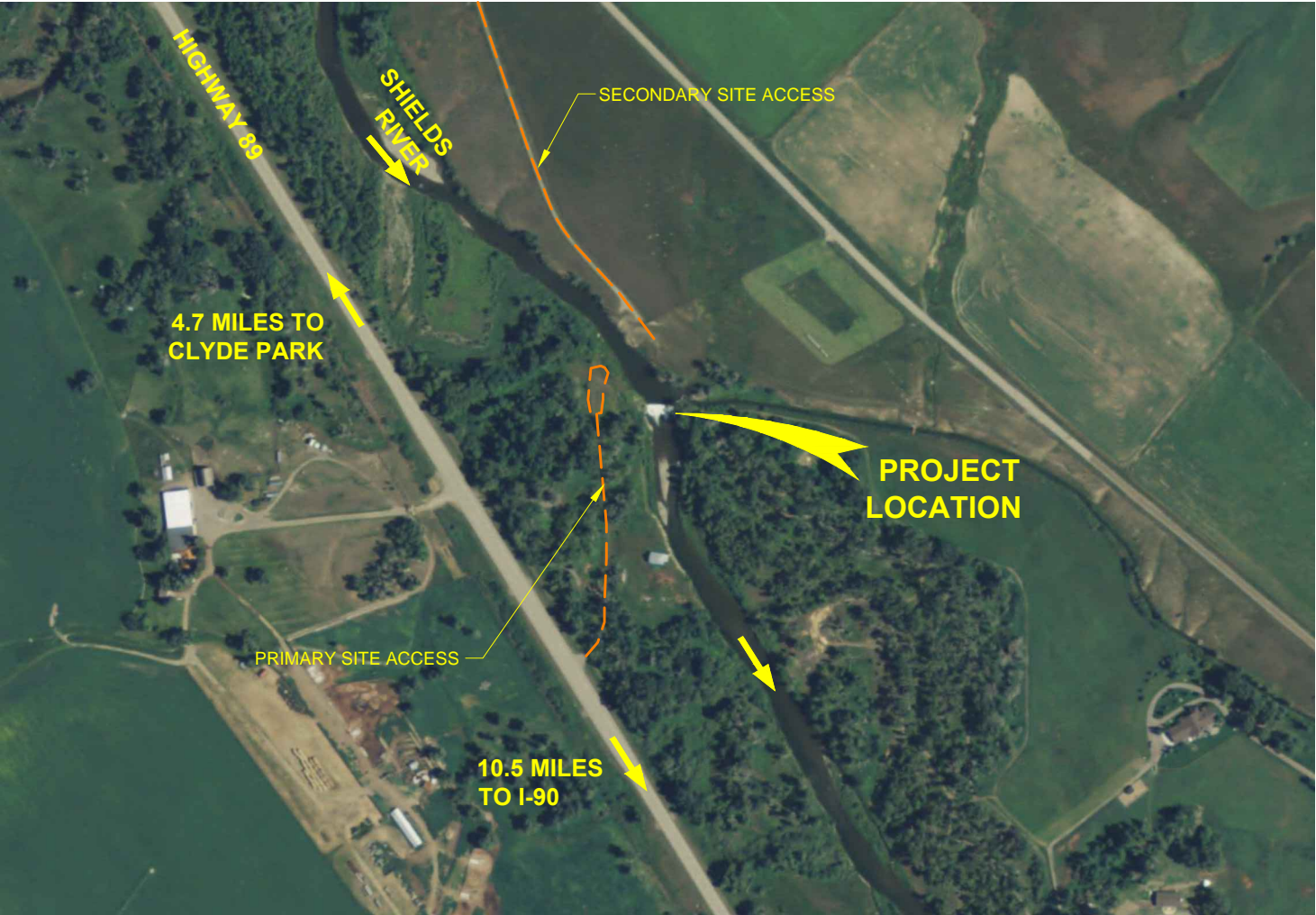
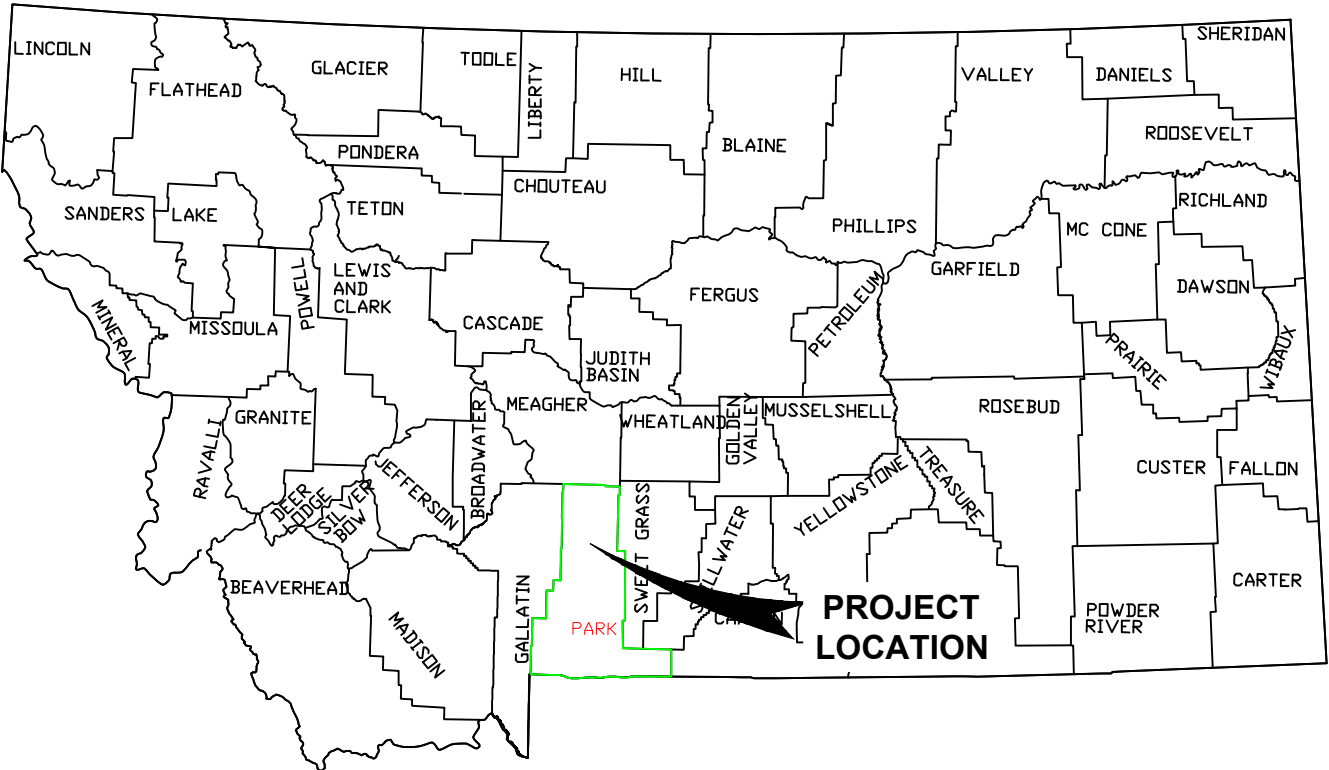
## DIVERSION RETROFIT & FISHERIES ENHANCEMENT PROJECT

Located in Section 13, Township 1N, Range 9E  
Latitude = 45.8297 North; Longitude = 110.5595 West  
Park County, Montana

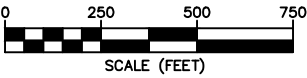
OWNER: LOWER SHIELDS RIVER CANAL COMPANY  
COOPERATING AGENCY: MONTANA FISH, WILDLIFE & PARKS  
JUNE 27, 2012

### SHEET INDEX

SHEET NO.		SHEET NO.	
T-1	TITLE PAGE	D-1	DETAILS -- FISH BARRIER & CHANNEL
N-1	ABBREVIATIONS AND NOTATIONS	D-2	DETAILS -- FISH BARRIER & CHANNEL
H-1	SURVEY CONTROL AND EXISTING CONDITIONS	D-3	DETAILS -- FISH BARRIER & CHANNEL
G-1	PROJECT OVERVIEW	D-4	DETAILS -- FISH BARRIER & CHANNEL
BMP-1	BEST MANAGEMENT PRACTICES PLAN	D-5	DETAILS -- FISH BARRIER & CHANNEL
GP-1	GRADING PLAN	D-6	DETAILS -- FISH TRAP & CHANNEL
DP-1	DESIGN PLAN	D-7	DETAILS -- FISH TRAP & CHANNEL
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PR-2	PROFILE -- FISH TRAP CHANNEL	D-9	DETAILS -- FISH TRAP & CHANNEL
XS-1	CROSS-SECTION OVERVIEW	CW-1	CONTROL OF WATER
XS-2	CROSS-SECTIONS -- CHANNEL	CW-2	CONTROL OF WATER DETAILS
XS-3	CROSS-SECTIONS -- CHANNEL		
XS-4	CROSS-SECTIONS -- CHANNEL		
XS-5	CROSS-SECTIONS -- CHANNEL		



### VICINITY MAP



## CONSTRUCTION PLANS

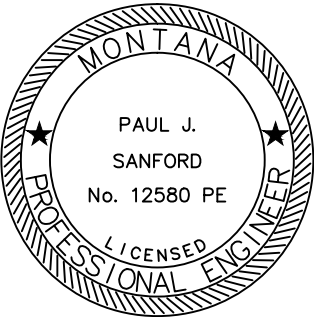
120 SOUTH MAIN STREET,  
LOWER LEVEL  
STANLEY, ND 58784  
PHONE (701) 629-0245  
www.alliedengineering.com

Civil Engineering  
Geotechnical Engineering  
Land Surveying



PROJECT ENGINEER:  
STRUCTURAL ENGINEER:  
GEOTECHNICAL ENGINEER:  
STAFF ENGINEER:  
FISHERIES & HYDRAULIC ENGINEER:  
FISHERIES & HYDRAULIC ENGINEER:  
SURVEYOR:

PAUL SANFORD, PE  
ERIK GARBERG, PE  
LEE EVANS, PE  
RORY S. ROMNEY, EI  
MATT BLANK, PE, PhD  
TOM COLEMAN, PE  
KYLE THOMPSON, LS



NOTE: REFER TO GENERAL NOTE 1 ON PLAN SHEET N-1 FOR DESCRIPTION AND IDENTIFICATION OF ENGINEER IN RESPONSIBLE CHARGE FOR THE VARIOUS PROJECT ELEMENTS.

Site Remediation  
Water Resources  
Ecological Sciences  
EHS Management

#1 NINTH STREET ISLAND DRIVE  
LIVINGSTON, MT 59047  
PHONE (406) 222-7600  
www.oasisenviro.com



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Water Resources

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BOZEMAN, MT 59718  
PHONE (406) 582-0221  
FAX (406) 582-5770  
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PROJECT # 10-146.20  
DATE: 06/27/2012

CHADBOURNE DIVERSION  
COVER SHEET

SHEET  
T-1

CHADBOURNE DIVERSION  
PARK COUNTY, MONTANA

DATE

REVISIONS

NO.

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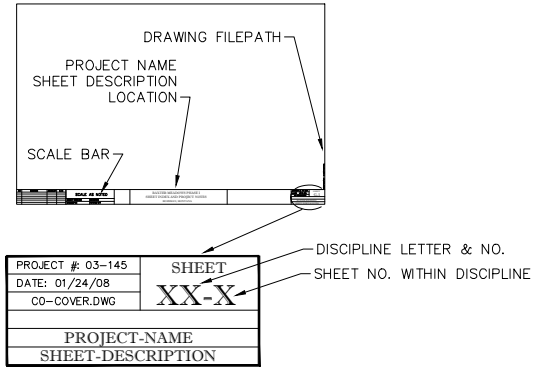
GENERAL NOTES:

1. THIS PLAN SET WAS DEVELOPED UNDER THE RESPONSIBLE CHARGE OF PAUL SANFORD, PE OF ALLIED ENGINEERING SERVICES, INC. AND MATT BLANK PE, PhD, OF ERM GROUP, INC. (OASIS ENVIRONMENTAL) AS DESCRIBED BELOW.

PAUL SANFORD IS THE CIVIL ENGINEER IN RESPONSIBLE CHARGE FOR THE CIVIL ENGINEERING COMPONENTS OF THE PROJECT. HIS STAMP APPEARS ON THE COVER SHEET OF THE PLANS.

MATT BLANK IS THE FISHERIES AND HYDRAULIC ENGINEER IN RESPONSIBLE CHARGE FOR THE HYDRAULIC ANALYSIS AND THE GEOMETRIC LAYOUT OF THE FISH TRAP AND FISH BARRIER. HIS STAMP APPEARS BELOW.

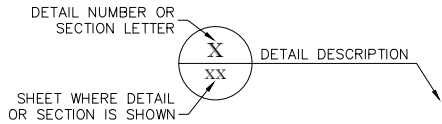
STANDARD BORDER FORMAT



STANDARD SHEET DESIGNATION

LETTER	DISCIPLINE
T-X	TITLE PAGE
N-X	ABBREVIATIONS & NOTATIONS
H-X	SURVEY CONTROL
G-X	OVERVIEW PLANS
BMP-X	BEST MANAGEMENT PRACTICES PLANS
GP-X	GRADING PLANS
DP-X	DESIGN PLANS
VP-X	VEGETATION PLANS
PR-X	PROFILES
XS-X	CROSS-SECTIONS
D-X	DETAILS
PH-X	PHASING PLANS
CW-X	CONTROL OF WATER PLANS

PLAN SHEET DETAIL CALLOUTS



ABBREVIATIONS:

AESI	ALLIED ENGINEERING SERVICES, INC.
AVG	AVERAGE
BLDG	BUILDING
BM	BENCHMARK
CL	CENTERLINE
CY	CUBIC YARD
DIA	DIAMETER
DBH	DIAMETER AT BREAST HEIGHT
DWG	DRAWING
E	EAST
EA	EACH
EG	EXISTING GRADE
ELEV	ELEVATION
EXT'G	EXISTING
FES	FABRIC ENCAPSULATED SOIL
FG	FINISHED GRADE
FT	FEET
FWP	MT. DEPT. of FISH WILDLIFE & PARKS
HORZ	HORIZONTAL
HWY	HIGHWAY
IN	INCH
LF	LINEAR FEET
LSRCC	LOWER SHIELDS RIVER CANAL COMPANY
LT	LEFT
MAT'L	MATERIAL
MAX	MAXIMUM
MH	MANHOLE
MIN	MINIMUM
N	NORTH
NIC	NOT IN CONTRACT
PL	PROPERTY LINE
PROP	PROPERTY
R	RADIUS
ROW	RIGHT OF WAY
RT	RIGHT
S	SOUTH
SECT	SECTION
STA	STATION
STD	STANDARD
TYP	TYPICAL
UG	UNDERGROUND
VERT	VERTICAL
W	WEST
W/	WITH
W/O	WITHOUT
WSE	WATER SURFACE ELEVATION

LEGEND

— 6165 —	INDEX CONTOUR - EG (5 FT INTERVAL)
— 6165 —	CONTOUR MINOR - EG (1 FT INTERVAL)
— 6165 —	INDEX CONTOUR - FG (5 FT INTERVAL)
— 6165 —	CONTOUR MINOR - FG (1 FT INTERVAL)
— — —	LIMITS OF DISTURBANCE
— — —	STREAM CENTERLINE
— — —	SURVEY CONTROL POINT
— — —	TEST PIT
— — —	EXT'G EDGE OF GRAVEL DRIVEWAY
— — —	EXT'G OVERHEAD POWER
— X — X —	EXT'G FENCE
— — —	EXISTING VEGETATION
— — —	STRAW WATTLE
— — —	PORTAGE SIGN

	CONCRETE
	BEDDING
	TOPSOIL
	NATIVE MATERIAL
	COMMON BACKFILL
	ROCK ARMOR
	SEEDING



CONTROL TABLE				
POINT	NORTHING	EASTING	ELEVATION	DESCRIPTION
1	577888.7460	1698390.5630	4667.0530	BASE - CONTROL
300	577806.5710	1698496.3170	4661.2130	BENCHMARK - ABUTMENT CORNER
400	577918.0800	1698321.6190	4666.2250	BENCHMARK
401	577795.6540	1698346.3730	4664.3750	BENCHMARK
405	577817.0190	1698469.2120	4666.8130	REBAR
407	577815.7590	1698594.9750	4665.6210	IRON PIPE
408	577889.9890	1698560.3850	4676.2400	IRON PIPE
409	578012.1950	1698429.7080	4673.0490	IRON PIPE

NOTE: THE LOCATIONS OF POINTS 400, 401, AND 409 ARE NOT DISPLAYED ON THIS SHEET. REFER TO SHEET G-1 FOR THE LOCATIONS OF THESE POINTS.

ALIGNMENT COORDINATE TABLE

Line Table: Alignments				
Line #	Length	Direction	Start Point	End Point
L1	36.90	N33° 43' 35.55"W	1698405.92,577973.61	1698385.44,578004.29
L2	64.03	N41° 23' 23.28"W	1698448.26,577925.57	1698405.92,577973.61
L3	82.93	N38° 11' 21.27"W	1698499.53,577860.38	1698448.26,577925.57
L4	57.43	N44° 56' 23.86"W	1698540.10,577819.73	1698499.53,577860.38
L5	88.29	N1° 15' 55.43"E	1698538.15,577731.47	1698540.10,577819.73
L6	21.28	N20° 43' 21.91"W	1698545.68,577711.56	1698538.15,577731.47
L7	33.82	N21° 45' 25.79"W	1698558.22,577680.16	1698545.68,577711.56
L8	47.88	N5° 31' 34.18"W	1698562.83,577632.50	1698558.22,577680.16
L9	45.56	N1° 54' 58.28"E	1698561.30,577586.97	1698562.83,577632.50
L10	45.88	N0° 46' 58.73"E	1698560.68,577541.10	1698561.30,577586.97
L11	60.53	N1° 02' 45.91"W	1698561.78,577480.57	1698560.68,577541.10
L12	27.30	N1° 02' 45.91"W	1698562.28,577453.28	1698561.78,577480.57
L13	64.00	S49° 50' 21.91"W	1698472.44,577850.67	1698423.53,577809.40
L14	30.43	S40° 09' 38.09"E	1698423.53,577809.40	1698443.16,577786.14
L16	34.57	S71° 12' 58.75"E	1698443.16,577786.14	1698475.88,577775.01
L17	23.05	S44° 40' 58.44"E	1698475.88,577775.01	1698492.09,577758.62

NOTES:

1. TOPOGRAPHIC SURVEY PERFORMED BY KYLE THOMPSON, LS AND JOHN PUGH, LS OF ALLIED ENGINEERING SERVICES, INC. ON DECEMBER 16, 2010 AND BY KYLE THOMPSON, LS OF ALLIED ENGINEERING SERVICES ON MARCH 10, 2012.

2. BEARINGS SHOWN ARE MONTANA STATE PLANE GRID. DISTANCES ARE GROUND DISTANCES IN INTERNATIONAL FEET.

MONTANA COORDINATE SYSTEM NAD 83  
HORIZONTAL DATUM: REFERENCED FROM NGS OPUS SOLUTION;  
ADJUSTED FROM NGS CORS (Continuously Operating Reference System)

PID	DESIGNATION
DL7335	MTDT HELENA CORS ARP
DL7705	NOMT NOMT_EBRY_MTI999 CORS ARP
AI5647	MAWY MAMMOTH WYOMING CORS ARP

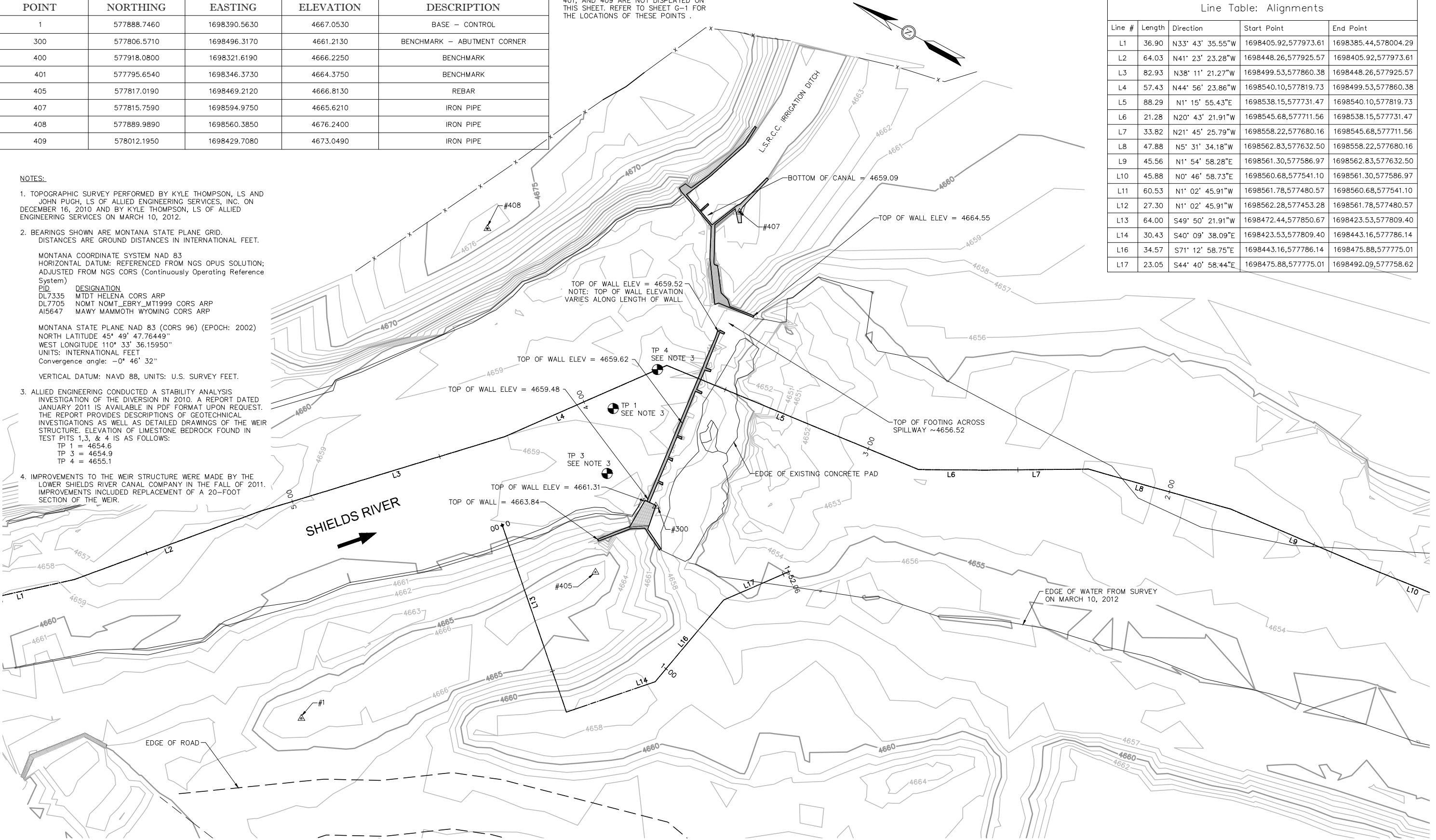
MONTANA STATE PLANE NAD 83 (CORS 96) (EPOCH: 2002)  
NORTH LATITUDE 45° 49' 47.76449"  
WEST LONGITUDE 110° 33' 36.15950"  
UNITS: INTERNATIONAL FEET  
Convergence angle: -0° 46' 32"

VERTICAL DATUM: NAVD 88, UNITS: U.S. SURVEY FEET.

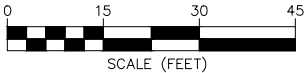
3. ALLIED ENGINEERING CONDUCTED A STABILITY ANALYSIS INVESTIGATION OF THE DIVERSION IN 2010. A REPORT DATED JANUARY 2011 IS AVAILABLE IN PDF FORMAT UPON REQUEST. THE REPORT PROVIDES DESCRIPTIONS OF GEOTECHNICAL INVESTIGATIONS AS WELL AS DETAILED DRAWINGS OF THE WEIR STRUCTURE. ELEVATION OF LIMESTONE BEDROCK FOUND IN TEST PITS 1, 3, & 4 IS AS FOLLOWS:

TP 1 = 4654.6  
TP 3 = 4654.9  
TP 4 = 4655.1

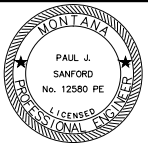
4. IMPROVEMENTS TO THE WEIR STRUCTURE WERE MADE BY THE LOWER SHIELDS RIVER CANAL COMPANY IN THE FALL OF 2011. IMPROVEMENTS INCLUDED REPLACEMENT OF A 20-FOOT SECTION OF THE WEIR.



NO.	REVISIONS	DRAWN BY	DATE



PROJECT ENGINEER: PJS  
DESIGNED BY: PJS, RSR  
DRAWN BY: RSR  
REVIEWED BY: PJS



SHIELDS RIVER - CHADBOURNE DIVERSION RETROFIT  
SURVEY CONTROL AND EXISTING CONDITIONS  
PARK COUNTY, MONTANA

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PROJECT #10-146.20  
DATE: 06/27/2012

SHEET  
H-1

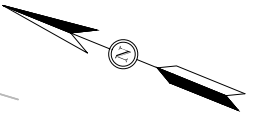
CHADBOURNE  
SURVEY CONTROL

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NOTE: REFER TO SPECIFICATIONS,  
SPECIFICALLY SECTIONS 02210 AND  
02220.



SEEDING

STRAW WATTLE TYP.

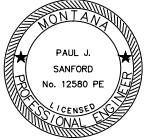
SEEDING ON LOWER BENCH

EDGE OF ROAD

LIMITS OF DISTURBANCE

STAGING AREA

SEEDING



SHIELDS RIVER - CHADBOURNE DIVERSION RETROFIT  
BEST MANAGEMENT PRACTICES PLAN  
PARK COUNTY, MONTANA

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DATE: 06/27/2012

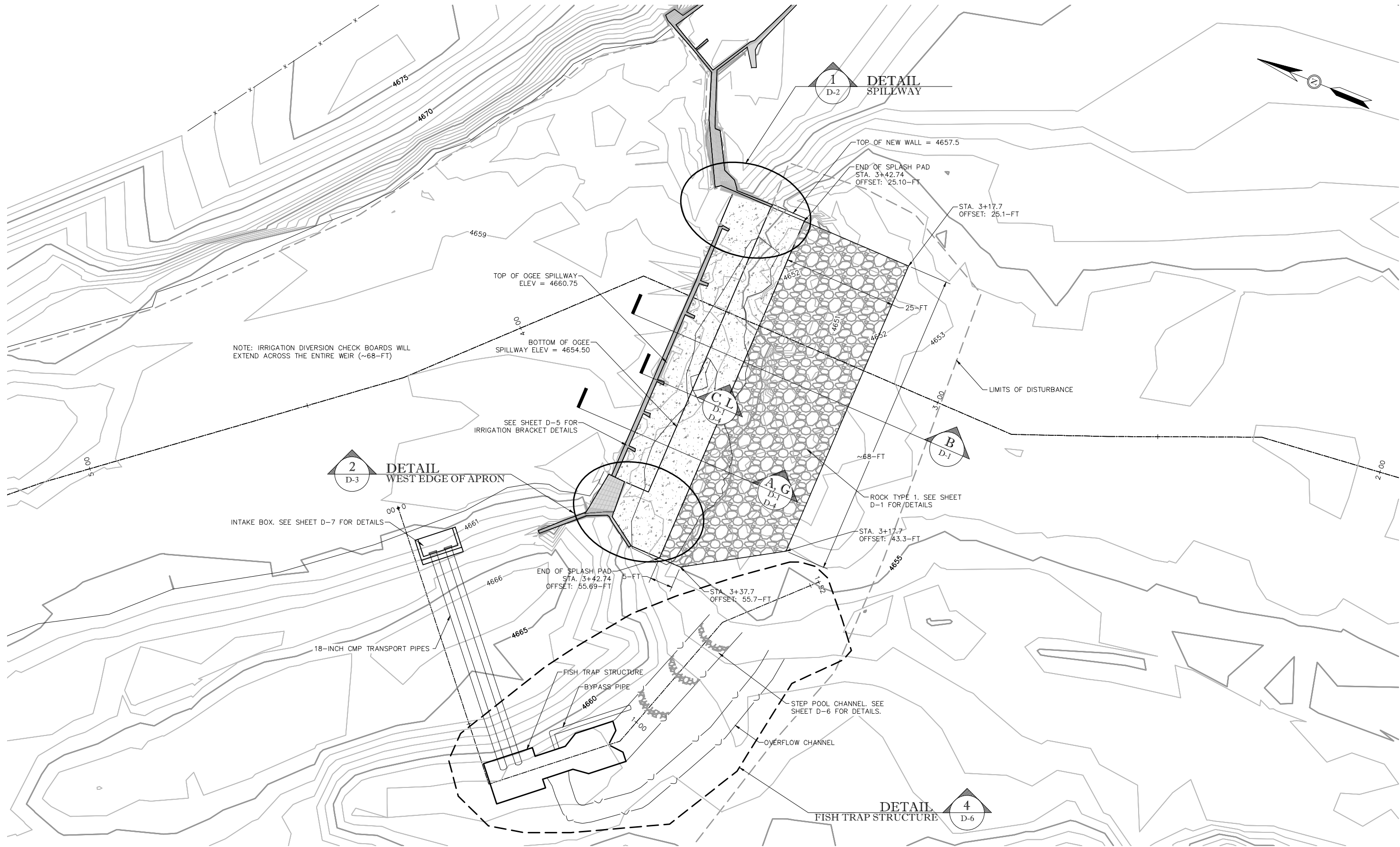
SHEET  
BMP-1

CHADBOURNE  
BMP PLAN

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NOTE: IRRIGATION DIVERSION CHECK BOARDS WILL  
EXTEND ACROSS THE ENTIRE WEIR (~68-FT)

SEE SHEET D-5 FOR  
IRRIGATION BRACKET DETAILS

INTAKE BOX. SEE SHEET D-7 FOR DETAILS

18-INCH CMP TRANSPORT PIPES

END OF SPLASH PAD  
STA. 3+42.74  
OFFSET: 55.69-FT

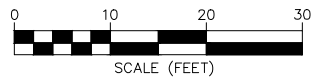
FISH TRAP STRUCTURE

BYPASS PIPE

STEP POOL CHANNEL. SEE  
SHEET D-6 FOR DETAILS.

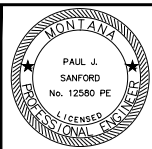
OVERFLOW CHANNEL

NO.	REVISIONS	DRAWN BY	DATE



PROJECT ENGINEER: PJS  
DESIGNED BY: PJS, RSR

DRAWN BY: RSR  
REVIEWED BY: PJS



SHIELDS RIVER - CHADBOURNE DIVERSION RETROFIT  
DESIGN PLAN  
PARK COUNTY, MONTANA

Site Remediation  
Water Resources  
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EHS Management

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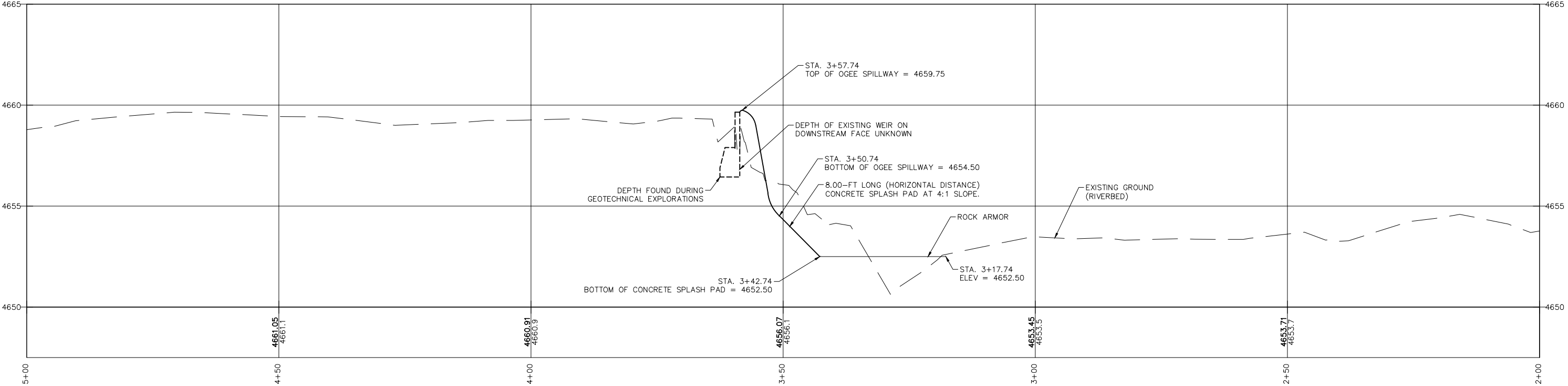
PROJECT #10-146.20  
DATE: 06/27/2012

CHADBOURNE  
DESIGN PLAN

SHEET  
DP-1

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RIVER PROFILE

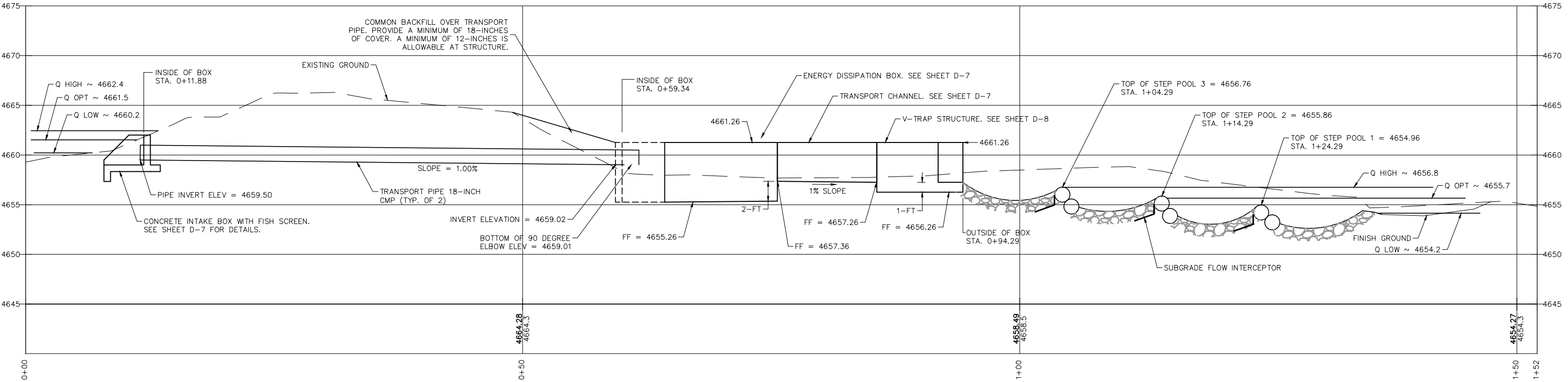


NO.	REVISIONS	DRAWN BY	DATE	HORIZONTAL SCALE FEET		VERTICAL SCALE FEET			SHIELDS RIVER - CHADBOURNE DIVERSION RETROFIT PROFILE - MAIN CHANNEL PARK COUNTY, MONTANA	 #1 NINTH STREET ISLAND DRIVE LIVINGSTON, MT 59047 PHONE (406) 222-7600 www.oasisenviro.com	 32 DISCOVERY DRIVE BOZEMAN, MT 59718 PHONE (406) 582-0221 FAX (406) 582-5770 www.alliedengineering.com	PROJECT #10-146.20	SHEET PR-1
				0 10 20		0 2.5 5						DATE: 06/27/2012	
				PROJECT ENGINEER: PJS		DRAWN BY: RSR						CHADBOURNE PROFILE - MAIN CHANNEL	
				DESIGNED BY: PJS, RSR		REVIEWED BY: PJS							

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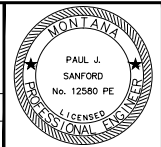
FISH PASSAGE



NOTES:  
1. WSE's LISTED ARE ESTIMATED BASED ON A HYDRAULIC MODEL BY OASIS ENVIRONMENTAL. REFER TO DESIGN CRITERIA MEMO FOR MORE INFORMATION.

NO.	REVISIONS	DRAWN BY	DATE

0 5 10 15 SCALE (FEET)	
PROJECT ENGINEER: PJS	DRAWN BY: RSR
DESIGNED BY: PJS, RSR	REVIEWED BY: PJS



SHIELDS RIVER - CHADBOURNE DIVERSION RETROFIT  
PROFILE - FISH TRAP CHANNEL  
PARK COUNTY, MONTANA

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**oasis  
ENVIRONMENTAL**

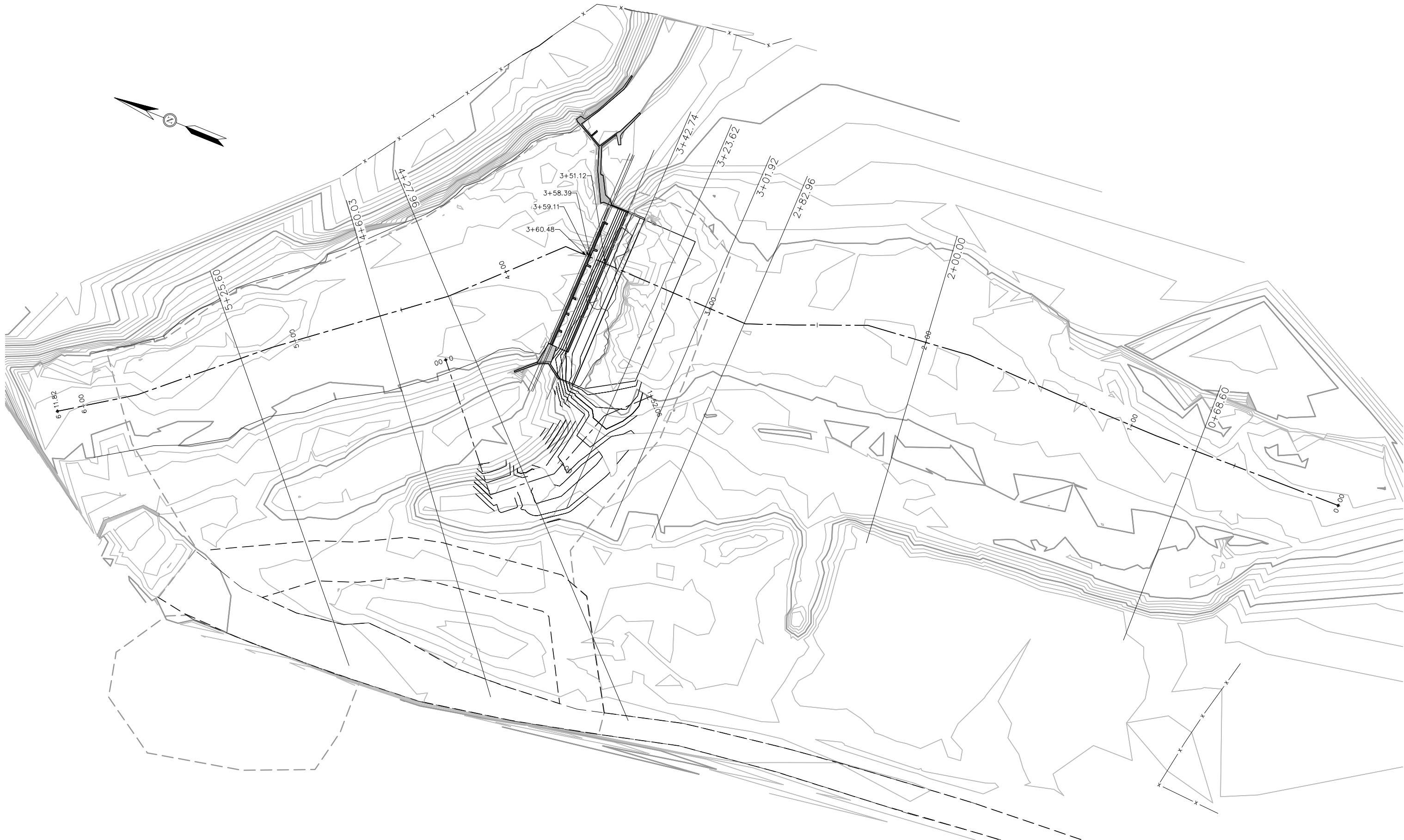
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**ALLIED  
ENGINEERING  
SERVICES, INC.**

Diverse Projects

PROJECT #10-146.20	SHEET PR-2
DATE: 06/27/2012	
CHADBOURNE PROFILE - FISH TRAP	

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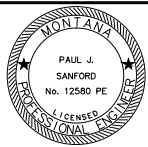


NO.	REVISIONS	DRAWN BY	DATE



PROJECT ENGINEER: PJS  
DESIGNED BY: PJS, RSR

DRAWN BY: RSR  
REVIEWED BY: PJS



SHIELDS RIVER - CHADBOURNE DIVERSION RETROFIT  
CROSS-SECTION OVERVIEW  
PARK COUNTY, MONTANA

Site Remediation  
Water Resources  
Ecological Sciences  
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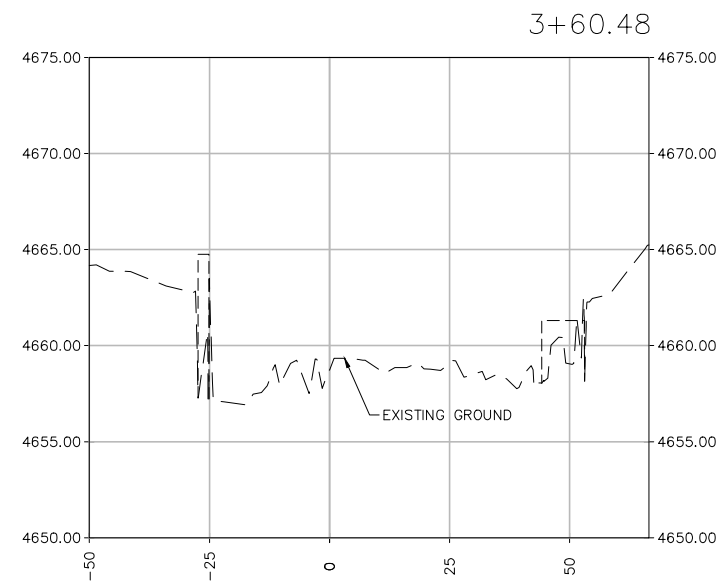
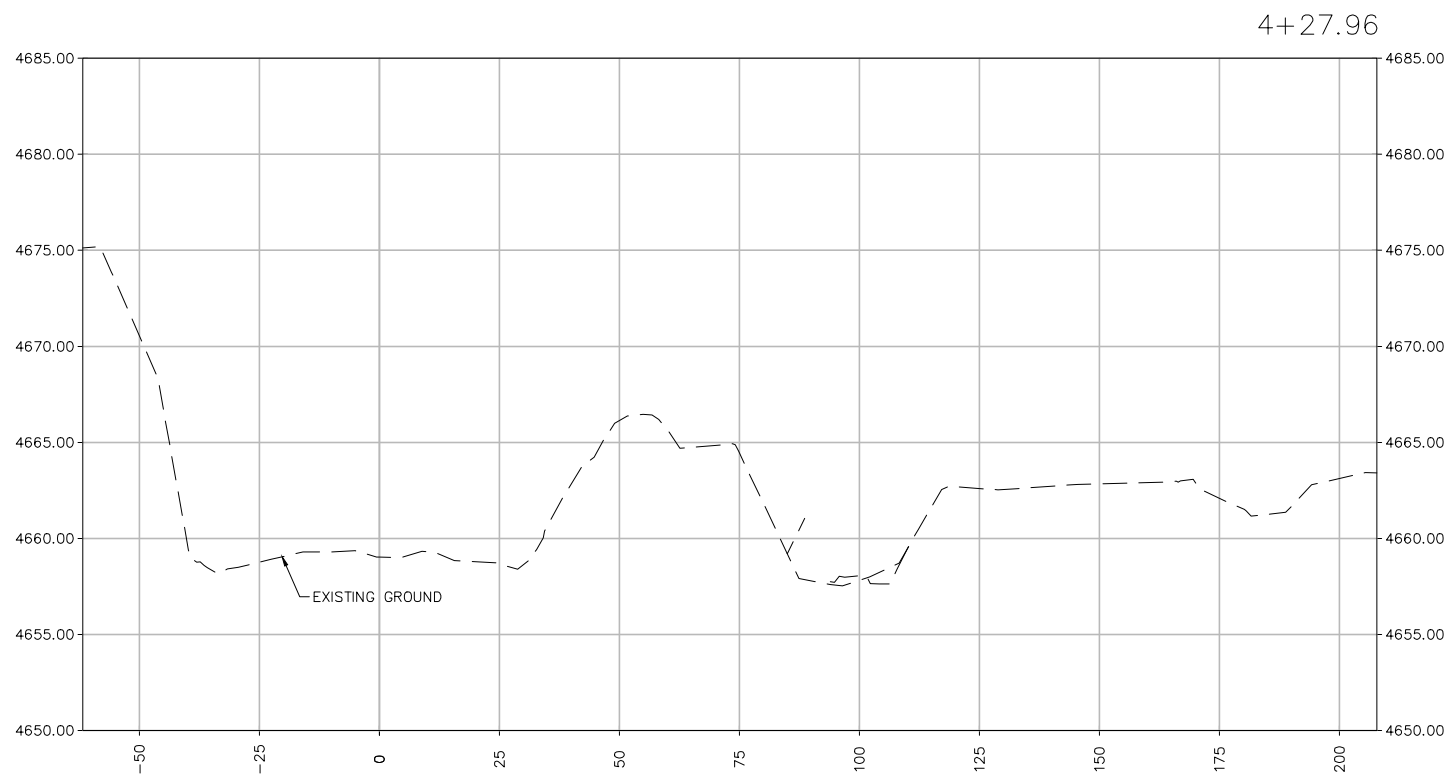
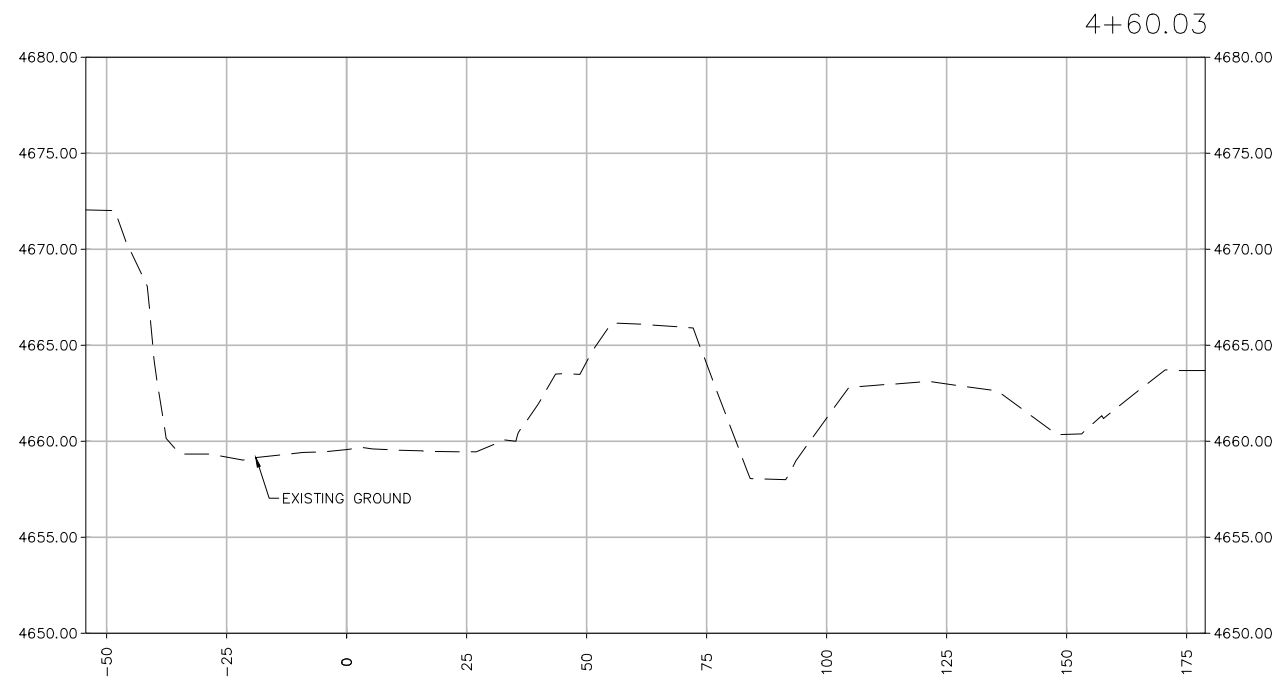
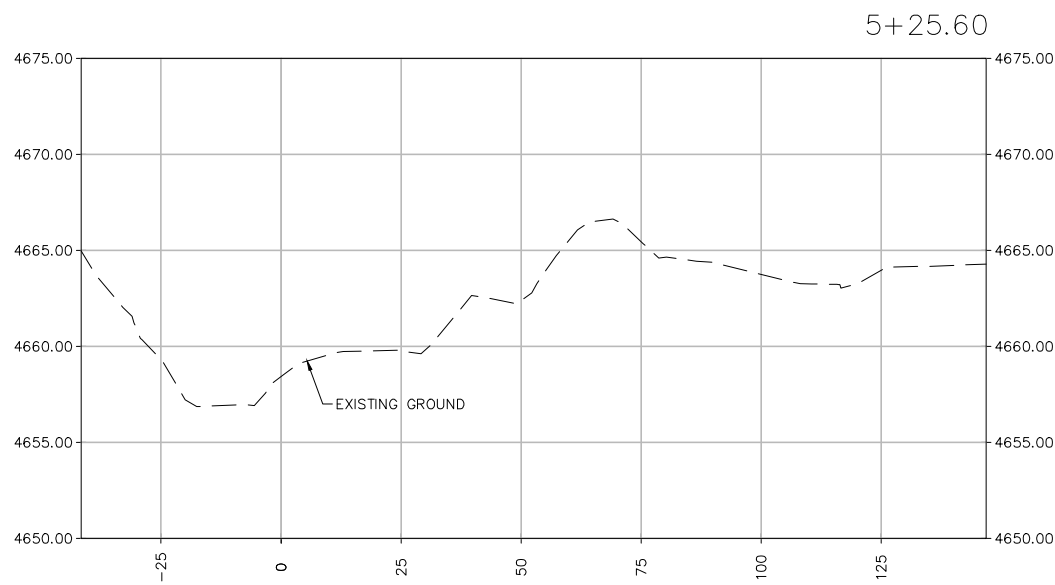


PROJECT #10-146.20  
DATE: 06/27/2012

CHADBOURNE  
CROSS-SECTION - CHANNEL

SHEET  
XS-1

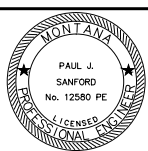




NOTE: VIEWED LOOKING DOWNSTREAM

NO.	REVISIONS	DRAWN BY	DATE

HORIZONTAL SCALE FEET	VERTICAL SCALE FEET
0 20 40	0 2 4
PROJECT ENGINEER: PJS	DRAWN BY: RSR
DESIGNED BY: PJS, RSR	REVIEWED BY: PJS



# SHIELDS RIVER - CHADBOURNE DIVERSION RETROFIT CROSS-SECTIONS CHANNEL PARK COUNTY, MONTANA

Site Remediation  
Water Resources  
Ecological Sciences  
EHS Management



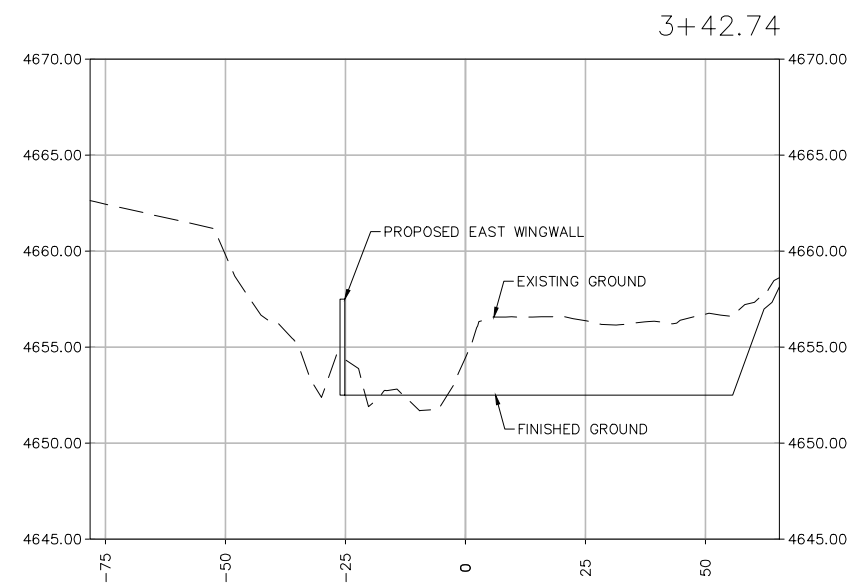
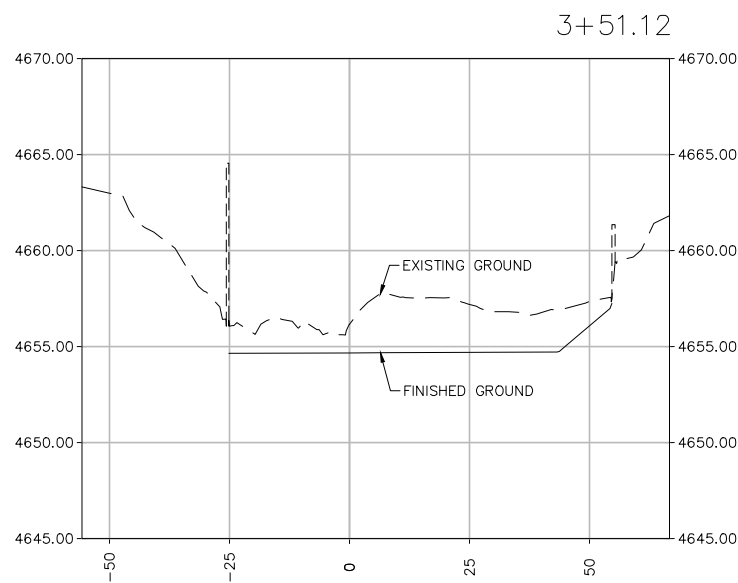
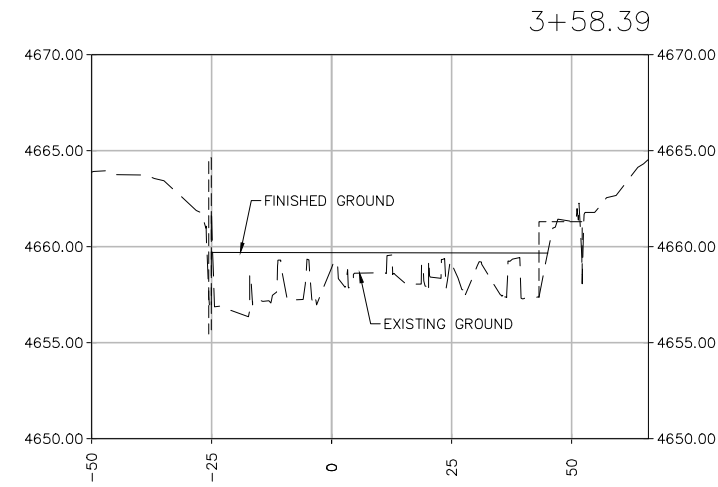
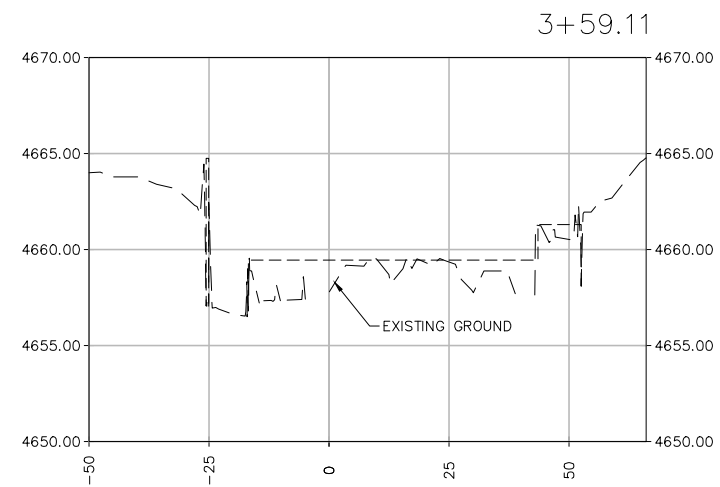
Civil Engineering  
Geotechnical Engineering  
Land Surveying  
Water Resources



PROJECT #10-146.20
DATE: 06/27/2012
CHADBOURNE
CROSS-SECTIONS - CHANNEL

SHEET  
XS-2

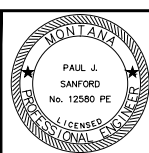
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NOTE: VIEWED LOOKING DOWNSTREAM

NO.	REVISIONS	DRAWN BY	DATE

HORIZONTAL SCALE FEET	VERTICAL SCALE FEET
0 20 40	0 2 4
PROJECT ENGINEER: PJS	DRAWN BY: RSR
DESIGNED BY: PJS, RSR	REVIEWED BY: PJS



# SHIELDS RIVER - CHADBOURNE DIVERSION RETROFIT CROSS-SECTION OVERVIEW - CHANNEL PARK COUNTY, MONTANA

Site Remediation  
Water Resources  
Ecological Sciences  
EHS Management

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PHONE (406) 222-7600  
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Land Surveying  
Water Resources

32 DISCOVERY DRIVE  
BOZEMAN, MT 59718  
PHONE (406) 582-0221  
FAX (406) 582-5770  
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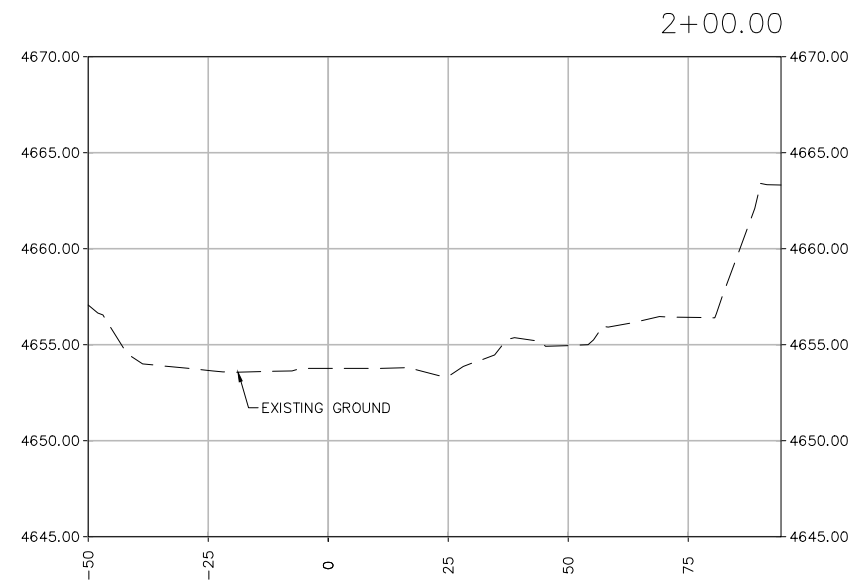
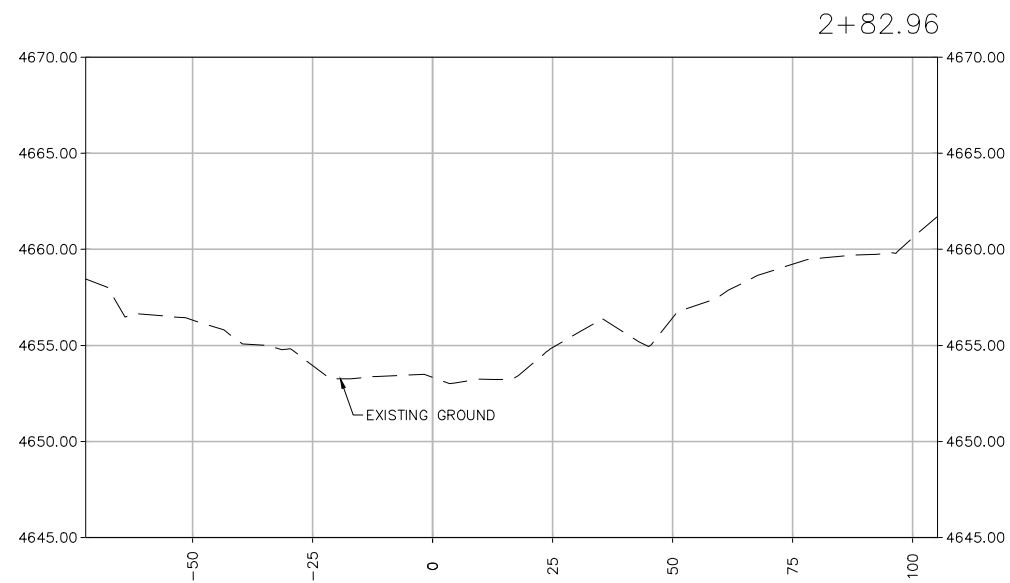
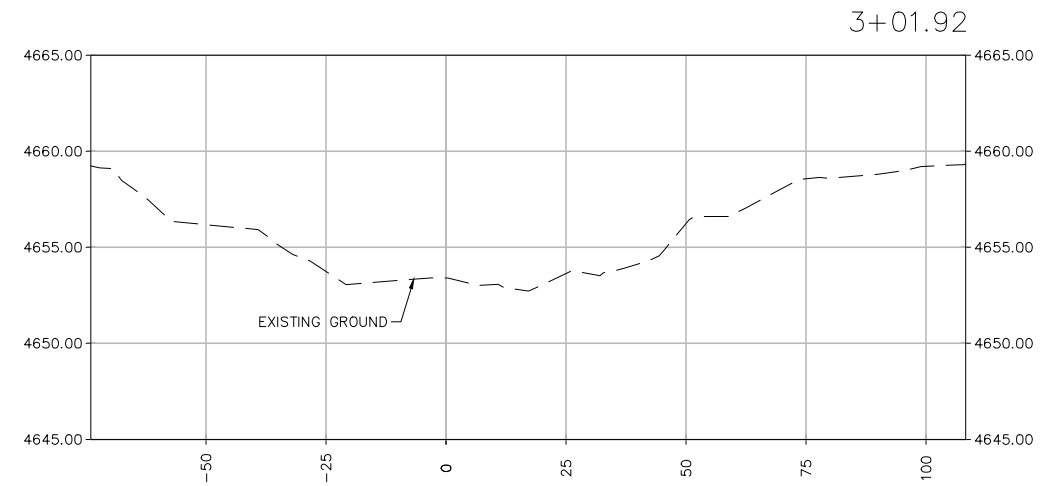
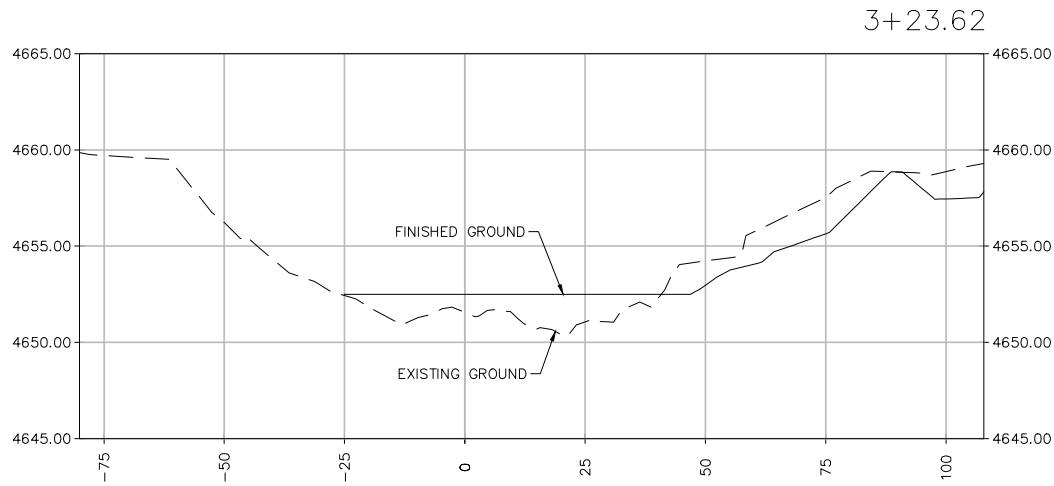
PROJECT #10-146.20  
DATE: 06/27/2012

CHADBOURNE  
CROSS-SECTION - CHANNEL

SHEET  
XS-3

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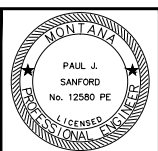




NOTE: VIEWED LOOKING DOWNSTREAM

NO.	REVISIONS	DRAWN BY	DATE

HORIZONTAL SCALE FEET	VERTICAL SCALE FEET
0 20 40	0 2 4
PROJECT ENGINEER: PJS	DRAWN BY: RSR
DESIGNED BY: PJS, RSR	REVIEWED BY: PJS



## SHIELDS RIVER - CHADBOURNE DIVERSION RETROFIT CROSS-SECTIONS - CHANNEL PARK COUNTY, MONTANA

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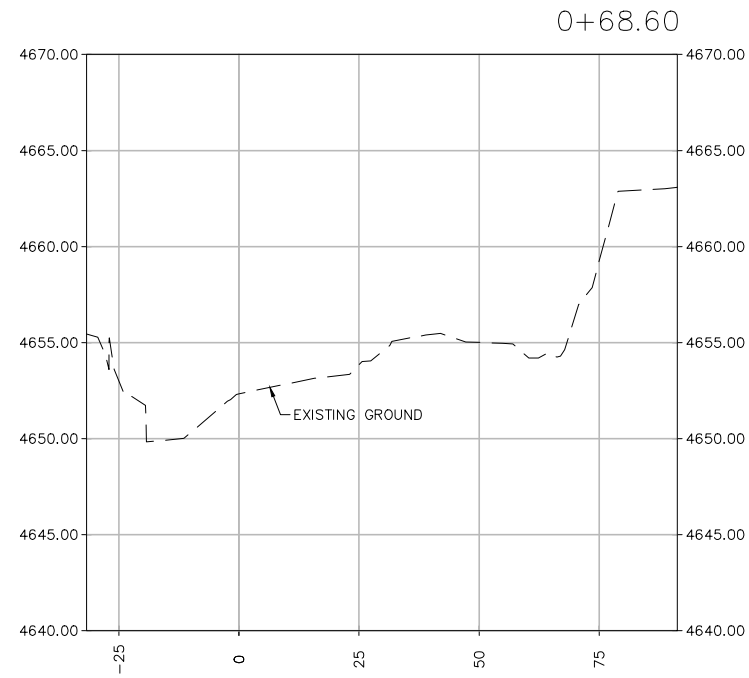
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PROJECT #10-146.20	SHEET XS-4
DATE: 06/27/2012	
CHADBOURNE	
CROSS-SECTIONS - CHANNEL	

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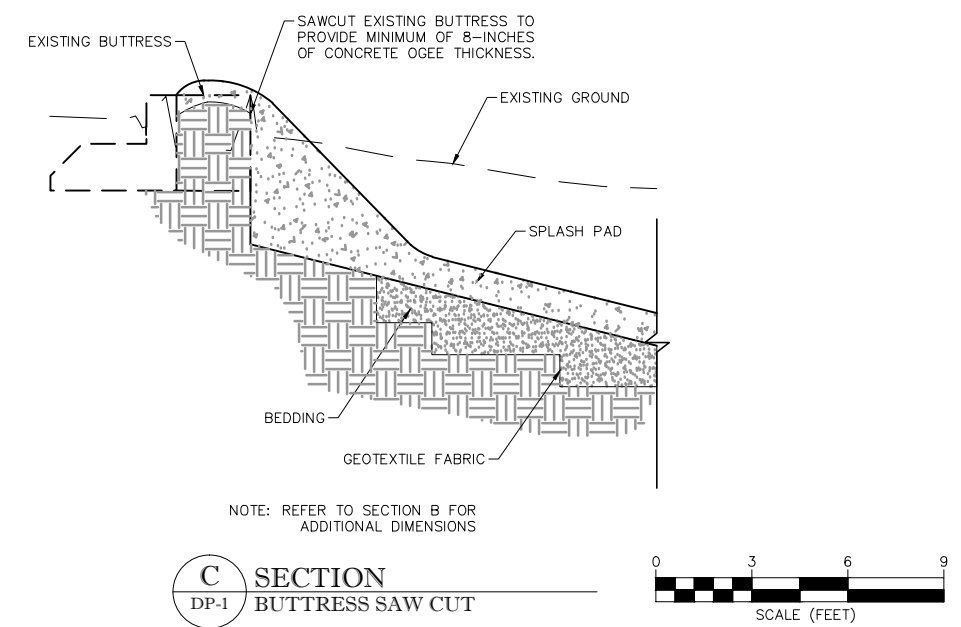


NOTE: VIEWED LOOKING DOWNSTREAM

NO.	REVISIONS	DRAWN BY	DATE	HORIZONTAL SCALE FEET		VERTICAL SCALE FEET			SHIELDS RIVER - CHADBOURNE DIVERSION RETROFIT CROSS-SECTIONS - CHANNEL PARK COUNTY, MONTANA	 <div>#1 NINTH STREET ISLAND DRIVE LIVINGSTON, MT 59047 PHONE (406) 222-7600 www.oasisenviro.com</div>	 <div>Civil Engineering Geotechnical Engineering Land Surveying Water Resources 32 DISCOVERY DRIVE BOZEMAN, MT 59718 PHONE (406) 582-0221 FAX (406) 582-5770 www.alliedengineering.com</div>	PROJECT #10-146.20	SHEET XS-5
				0 20 40		0 2 4						DATE: 06/27/2012	
				PROJECT ENGINEER: PJS		DRAWN BY: RSR						CHADBOURNE	
				DESIGNED BY: PJS, RSR		REVIEWED BY: PJS						CROSS-SECTIONS - CHANNEL	

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TOP OF EXISTING WEIR ~ 4659.7

SEE OGEE SPILLWAY PLOT AND TABLE FOR GEOMETRY. REFER TO SHEET D-4 FOR STRUCTURAL DETAILS.

3-FT FROM TOP OF WALL TO TOP OF APRON AT PROJECTED 4:1 SLOPE

EXISTING GROUND TO BE LEFT UNDISTURBED

6.25-FT TYP

~1-FT TYP

BEDDING

GEOTEXTILE FABRIC

1-FT

1-FT MIN

SPLASH PAD AT 4:1 SLOPE

1-FT

4.00-FT

5-FT

6-FT

1-FT

25-FT

SPLASH PAD FG = 4652.50

SCOUR HOLE ROCK ARMOR, ROCK TYPE 1

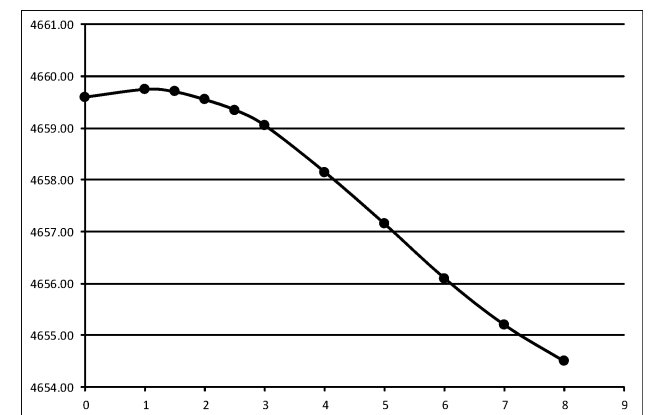
4-FT

EXISTING GROUND (RIVERBED)

**B** SECTION  
DP-1 APRON & SCOUR HOLE

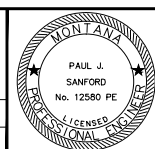
0 3 6 9  
SCALE (FEET)

STATION (FROM DOWNSTREAM EDGE OF WALL)	ELEVATION	COMMENTS
0	4659.60	(VARIES) CONNECTION TO EXISTING STRUCTURE
1	4659.75	OGEE CREST
1.5	4659.70	
2	4659.55	
2.5	4659.35	
3	4659.05	
4	4658.15	
5	4657.15	
6	4656.10	
7	4655.20	
8	4654.50	END OGEE SHAPE



NO.	REVISIONS	DRAWN BY	DATE

PROJECT ENGINEER: PJS	DRAWN BY: RSR
DESIGNED BY: PJS, RSR	REVIEWED BY: PJS



SHIELDS RIVER - CHADBOURNE DIVERSION RETROFIT  
DETAILS - FISH BARRIER & CHANNEL  
PARK COUNTY, MONTANA

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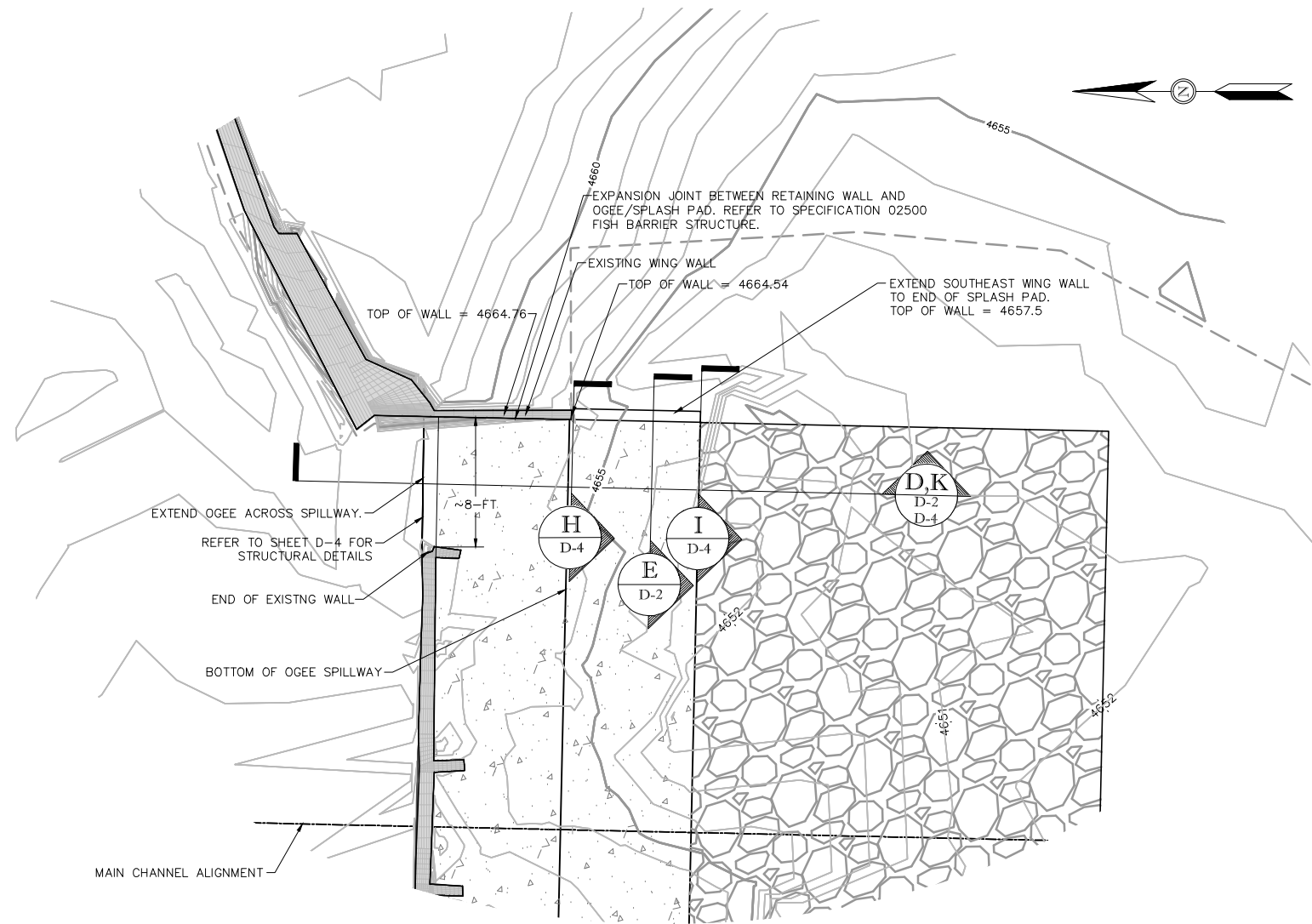


PROJECT #:	10-146.20
DATE:	06/27/2012

CHADBOURNE  
DETAILS - CHANNEL

SHEET  
D-1

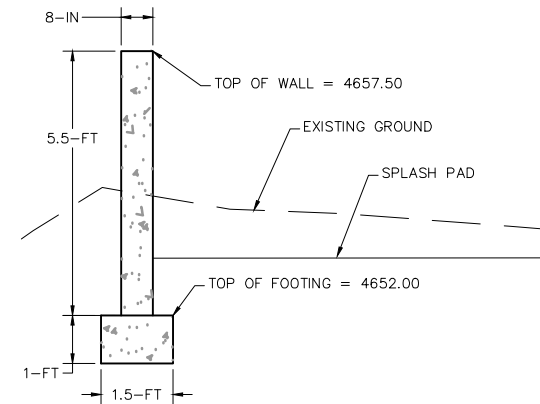
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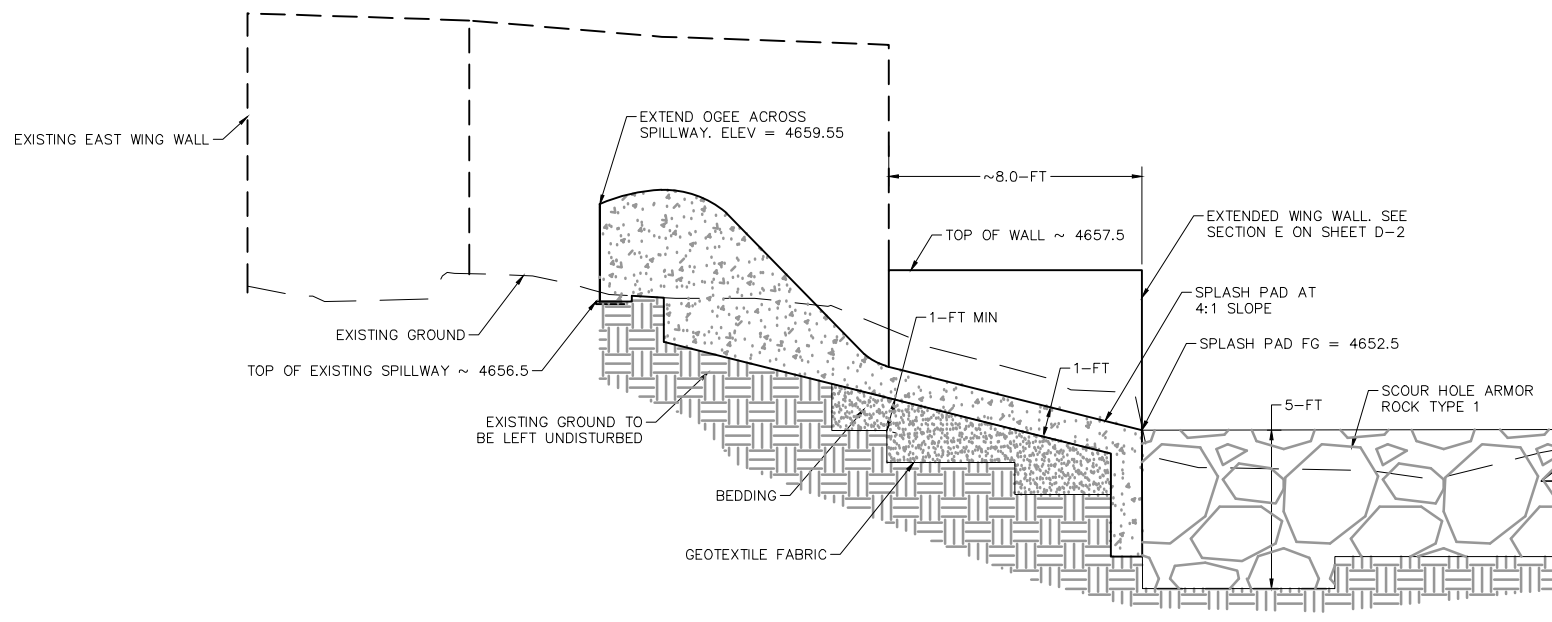
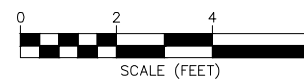
**1** **DETAIL**  
DP-1 **SPILLWAY**



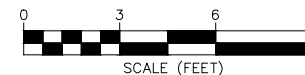
REFER TO SHEET D-4 FOR  
STRUCTURAL DETAILS.



**E** **SECTION**  
D-2 **EAST WINGWALL**

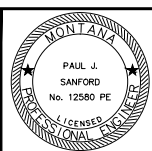


**D** **SECTION**  
D-2 **SPILLWAY**



NO.	REVISIONS	DRAWN BY	DATE

PROJECT ENGINEER: PJS  
DESIGNED BY: PJS, RSR  
DRAWN BY: RSR  
REVIEWED BY: PJS



**SHIELDS RIVER - CHADBOURNE DIVERSION RETROFIT  
DETAILS - FISH BARRIER & CHANNEL  
PARK COUNTY, MONTANA**

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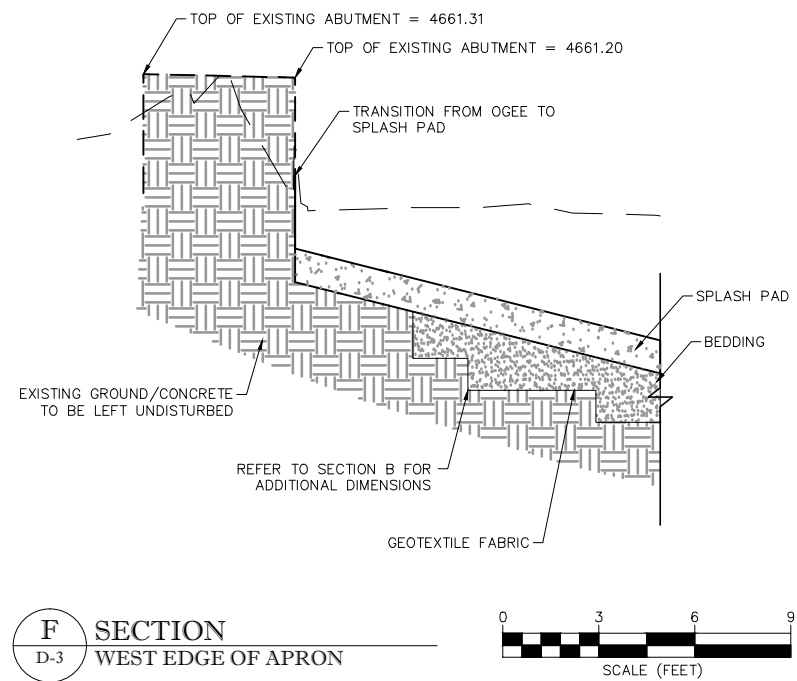
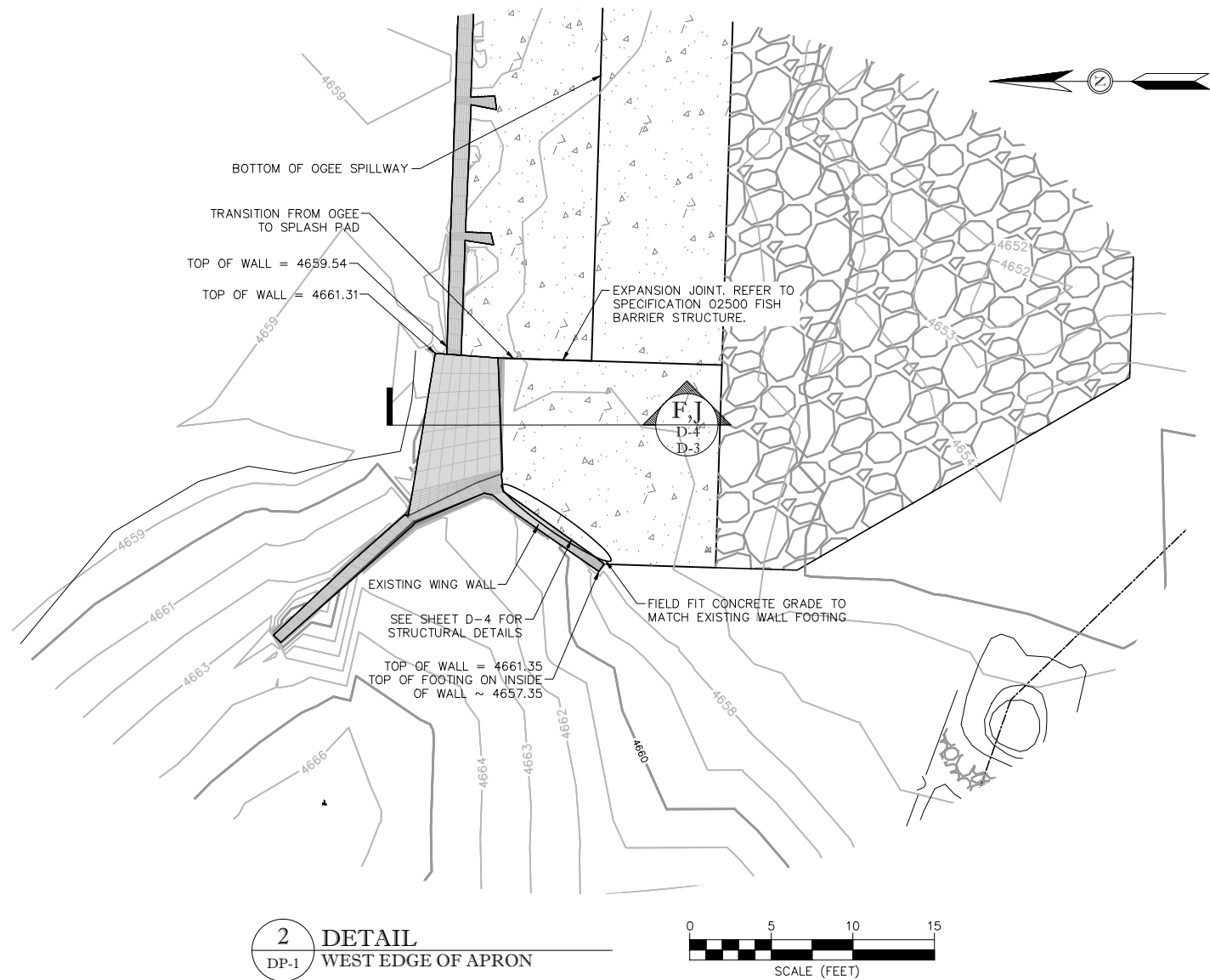
PROJECT #10-146.20  
DATE: 06/27/2012

**SHEET  
D-2**

**CHADBOURNE  
DETAILS - CHANNEL**

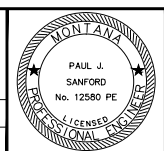
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NO.	REVISIONS	DRAWN BY	DATE

PROJECT ENGINEER: PJS	DRAWN BY: RSR
DESIGNED BY: PJS, RSR	REVIEWED BY: PJS



**SHIELDS RIVER - CHADBOURNE DIVERSION RETROFIT**  
**DETAILS - FISH BARRIER & CHANNEL**  
**PARK COUNTY, MONTANA**

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*Water Resources*  
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*EHS Management*  
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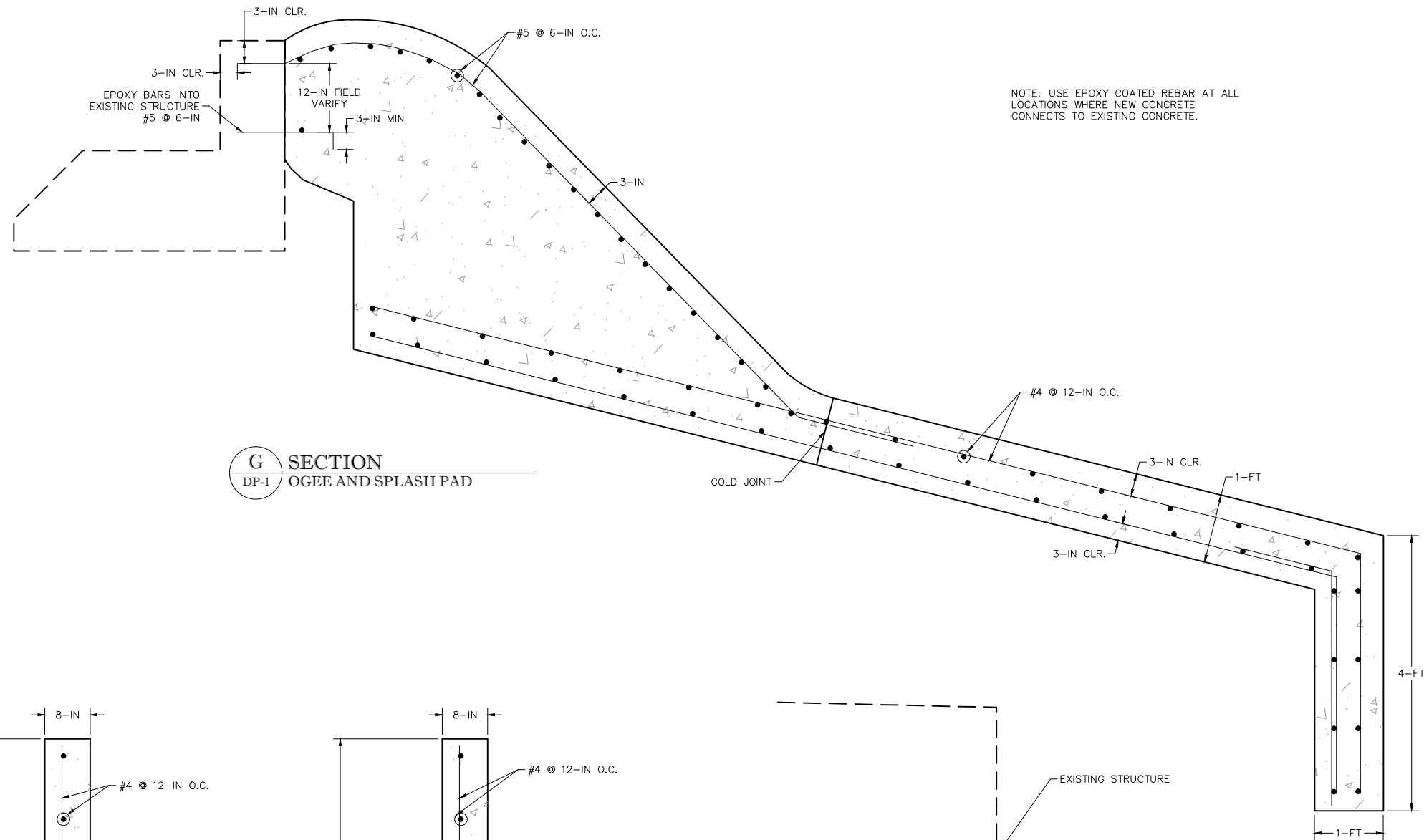


*Civil Engineering*  
*Geotechnical Engineering*  
*Land Surveying*  
*Water Resources*  
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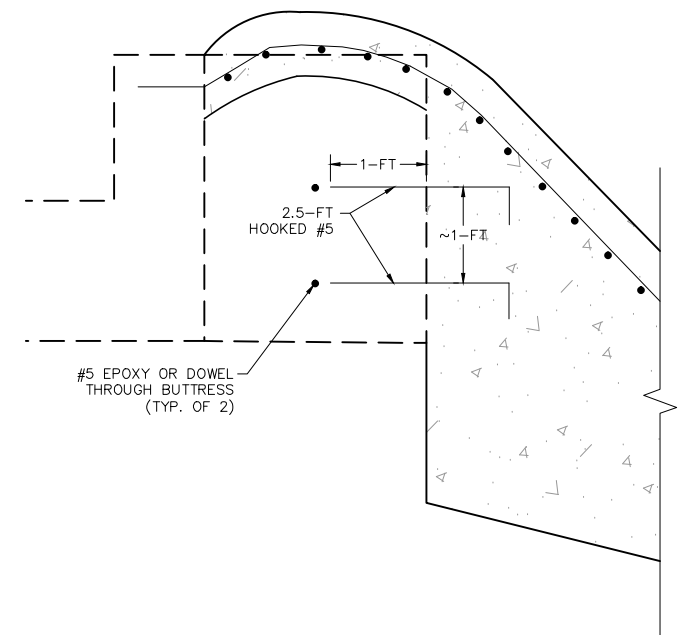


PROJECT #10-146.20	SHEET D-3
DATE: 06/27/2012	
CHADBOURNE CHANNEL	

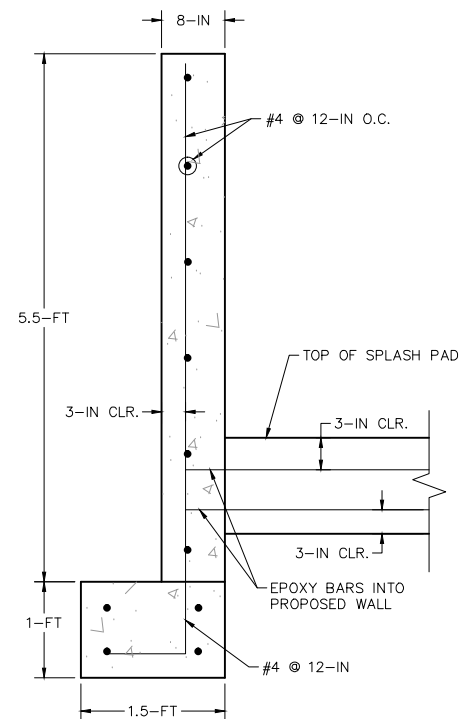
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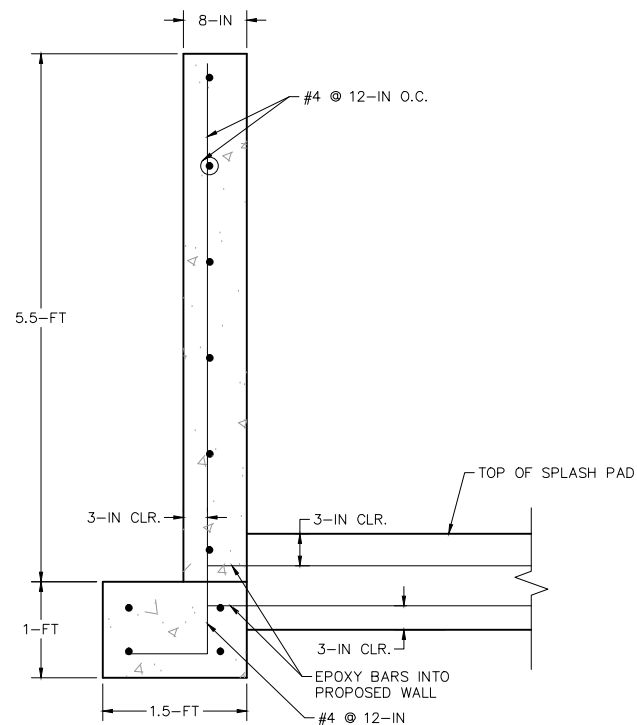
**G** SECTION  
DP-1 OGEE AND SPLASH PAD



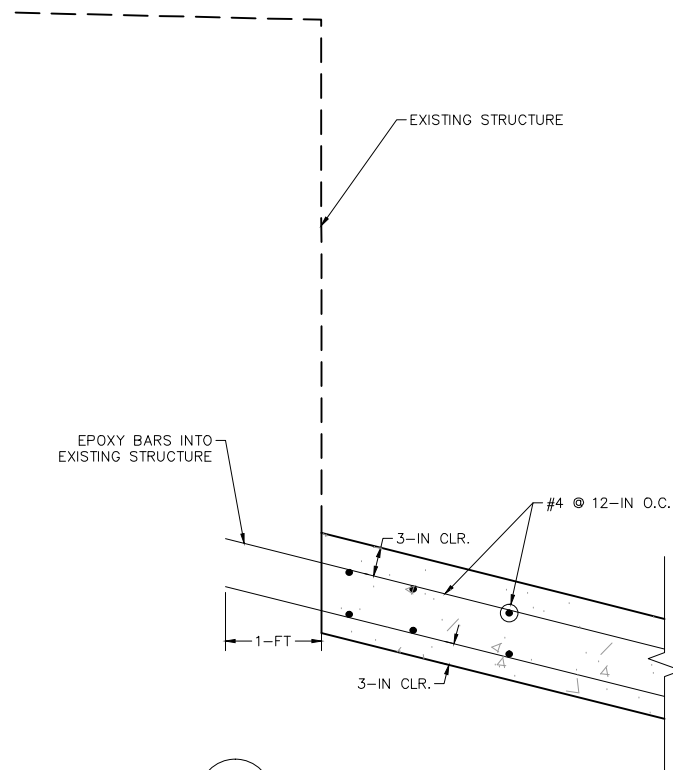
**L** SECTION  
DP-1 EAST WINGWALL



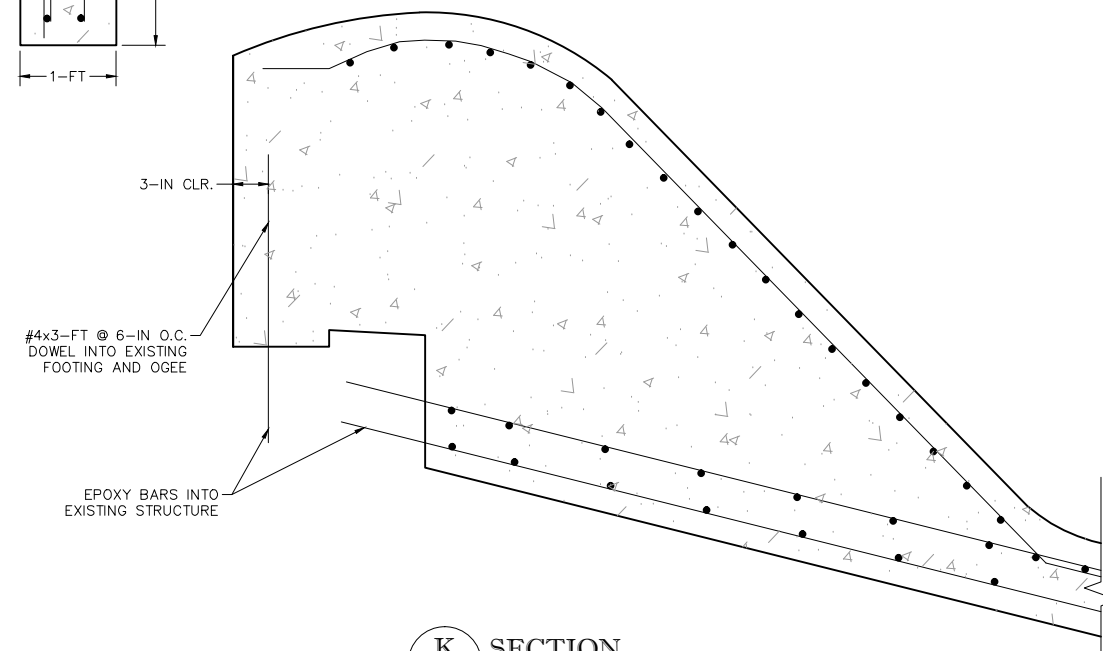
**H** SECTION  
D-2 EAST WINGWALL



**I** SECTION  
D-2 EAST WINGWALL



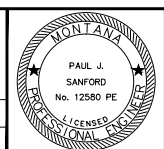
**J** SECTION  
D-3 WEST END OF APRON



**K** SECTION  
D-2 SPILLWAY

NO.	REVISIONS	DRAWN BY	DATE

0	1	2	3
SCALE (FEET)			
PROJECT ENGINEER: PJS	DESIGNED BY: PJS, RSR	DRAWN BY: RSR	REVIEWED BY: PJS



SHIELDS RIVER - CHADBOURNE DIVERSION RETROFIT  
DETAILS - FISH BARRIER & CHANNEL  
PARK COUNTY, MONTANA

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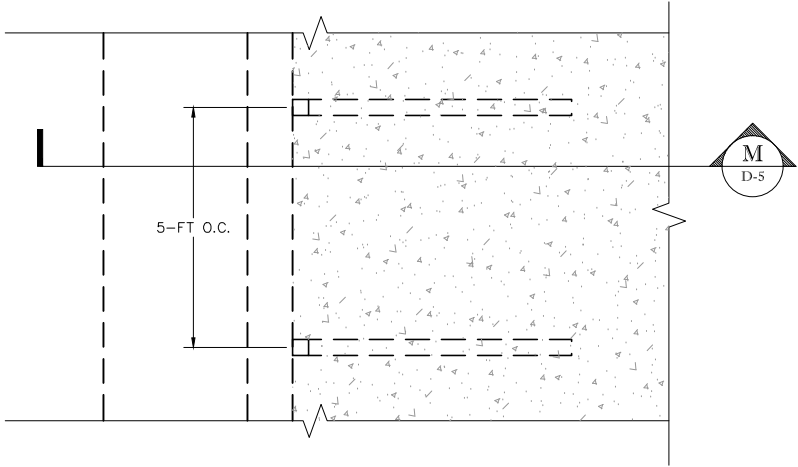
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PROJECT #10-146.20	SHEET D-4
DATE: 06/27/2012	
CHADBOURNE CHANNEL	

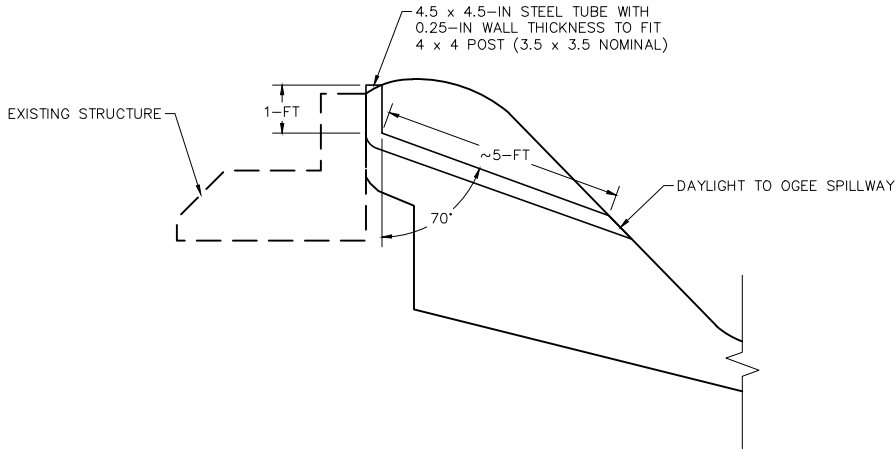
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- NOTES:
- 1. IRRIGATION DIVERSION CHECK BOARDS WILL EXTEND ACROSS THE ENTIRE WEIR (~68'-FT)
  - 2. REFER TO THE TABLE ON THIS SHEET FOR BRACKET LOCATIONS.



3  
DP-1  
DETAIL  
IRRIGATION BRACKET

BRACKET NUMBER	DISTANCE FROM INSIDE EDGE OF WEST ABUTMENT WALL
1	4
2	9
3	14
4	19
5	24
6	29
7	34
8	38.5
9	44
10	49
11	54
12	59
13	64



M  
D-5  
SECTION  
IRRIGATION BRACKET

NO.	REVISIONS	DRAWN BY	DATE



PROJECT ENGINEER: PJS  
DESIGNED BY: PJS, RSR  
DRAWN BY: RSR  
REVIEWED BY: PJS



SHIELDS RIVER - CHADBOURNE DIVERSION RETROFIT  
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PARK COUNTY, MONTANA

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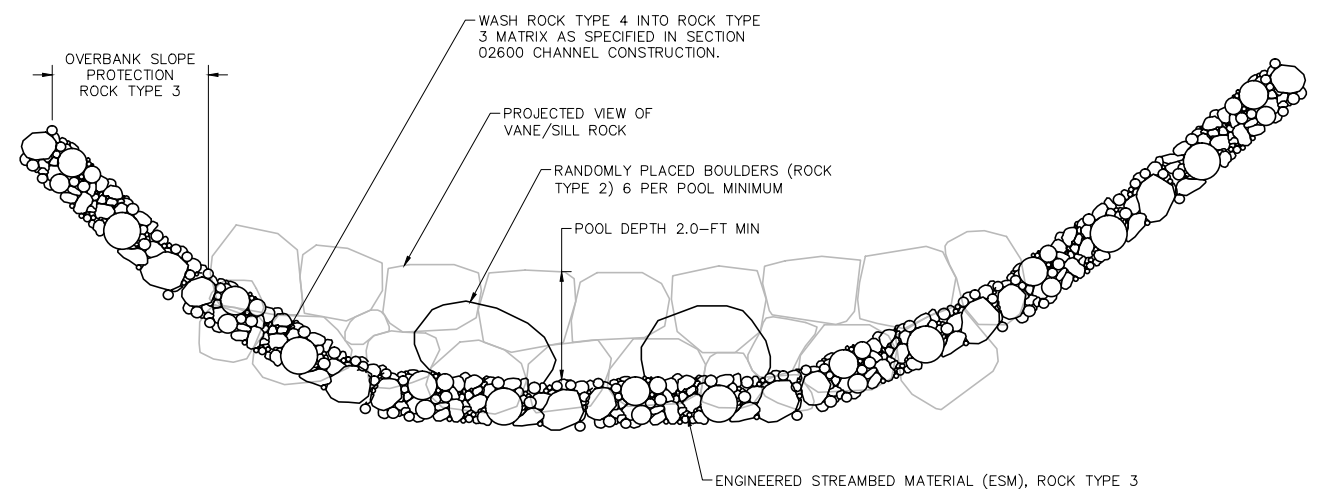
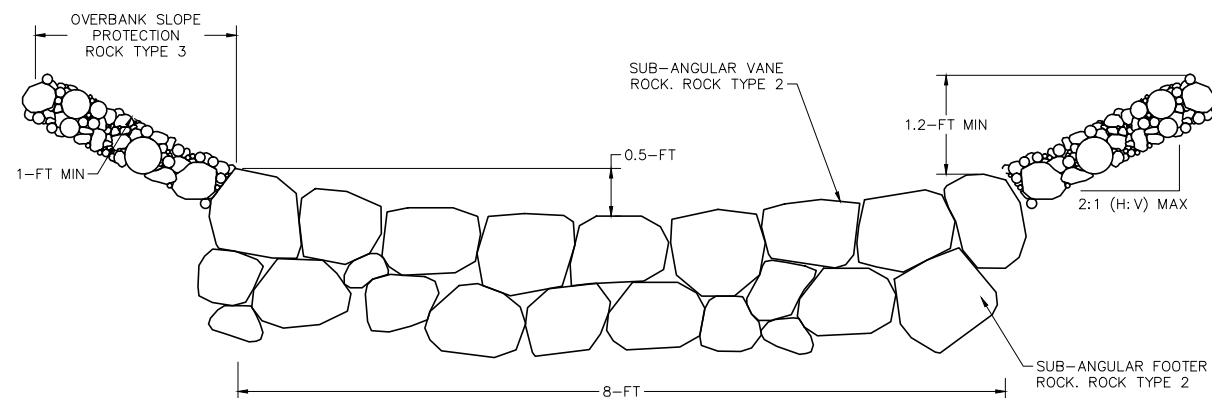
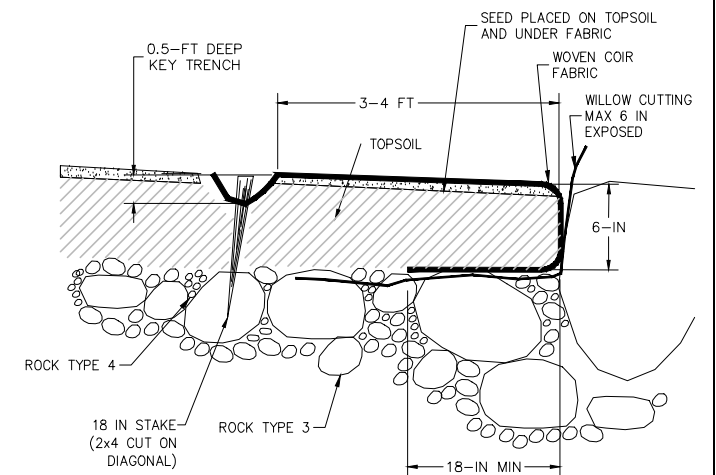
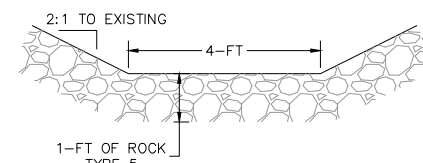
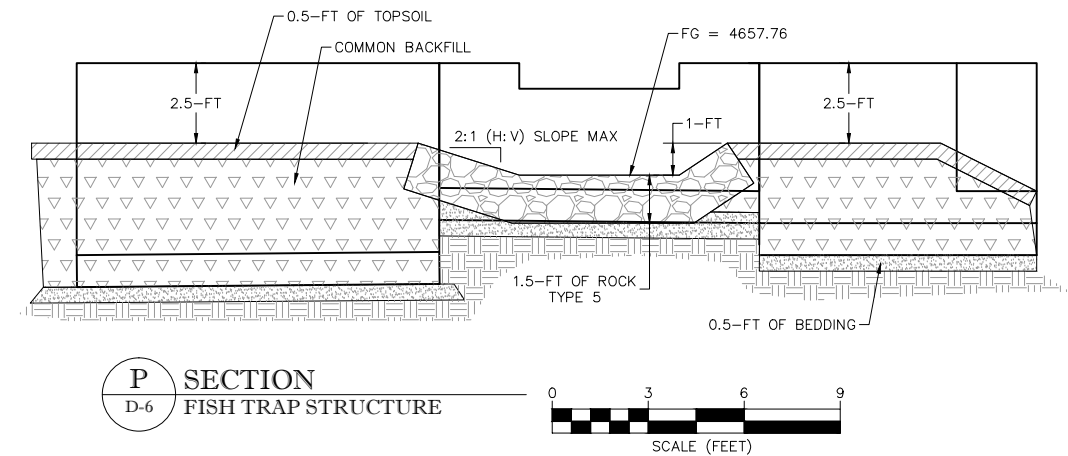
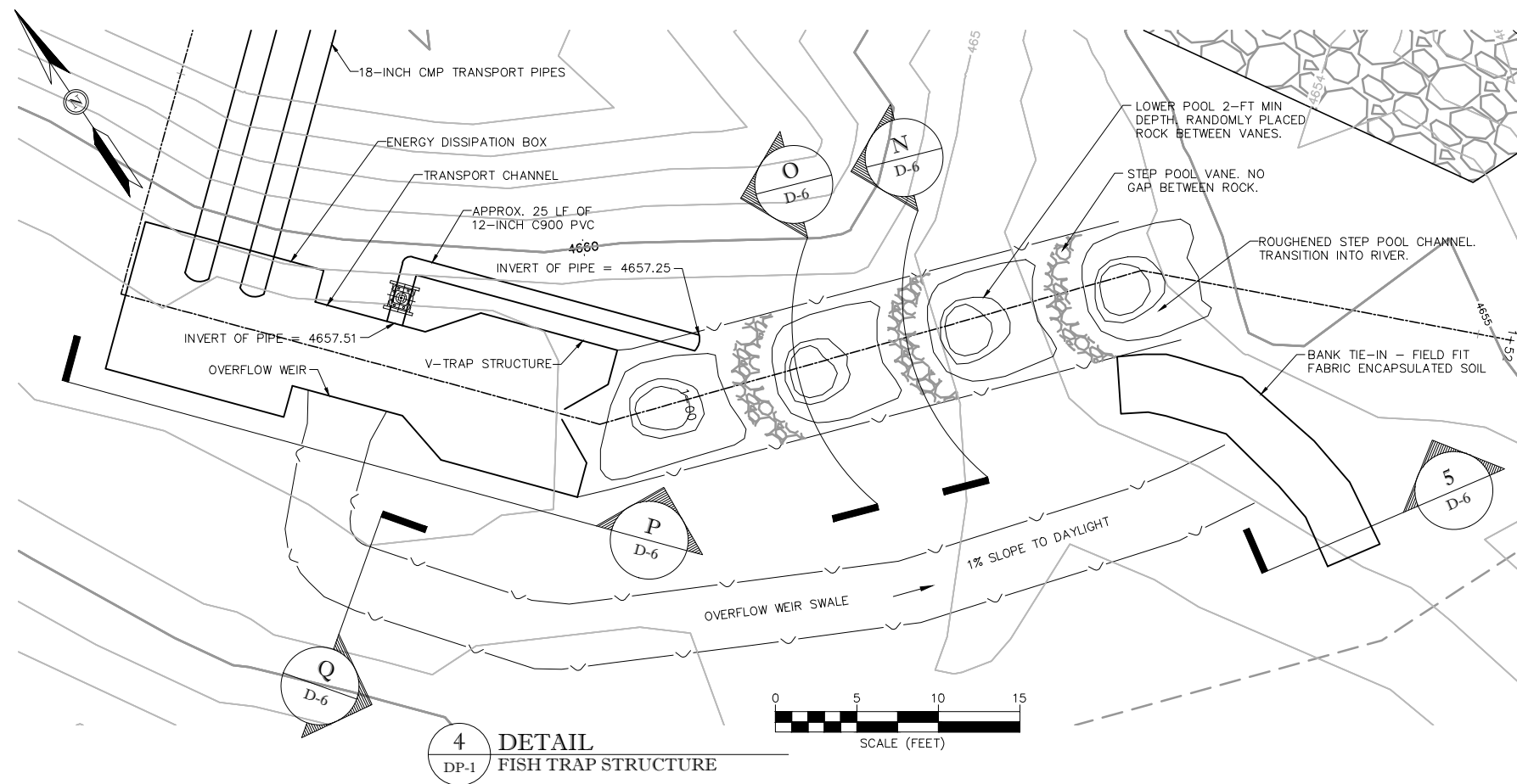


PROJECT #10-146.20  
DATE: 06/27/2012

CHADBOURNE  
CHANNEL

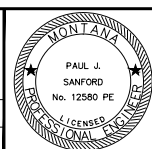
SHEET  
D-5





NO.	REVISIONS	DRAWN BY	DATE

PROJECT ENGINEER: PJS	DRAWN BY: RSR
DESIGNED BY: PJS, RSR	REVIEWED BY: PJS



SHIELDS RIVER - CHADBOURNE DIVERSION RETROFIT  
DETAILS - FISH TRAP & CHANNEL  
PARK COUNTY, MONTANA

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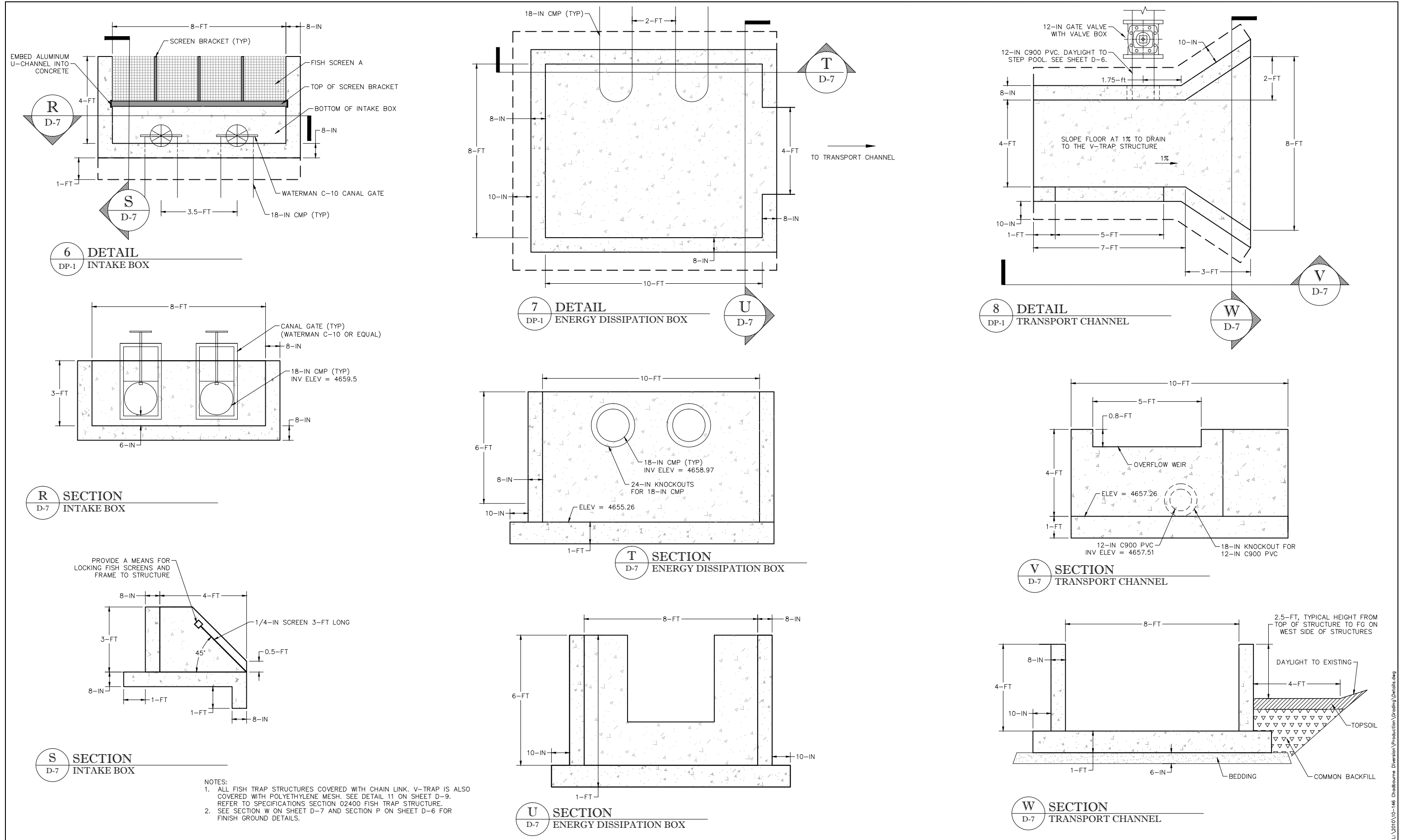


PROJECT #:	10-146.20
DATE:	06/27/2012

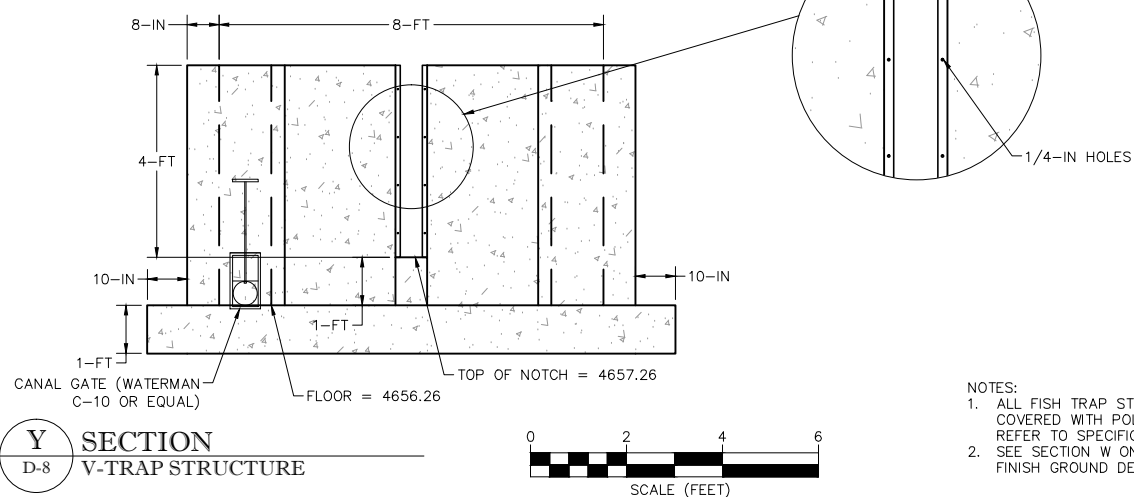
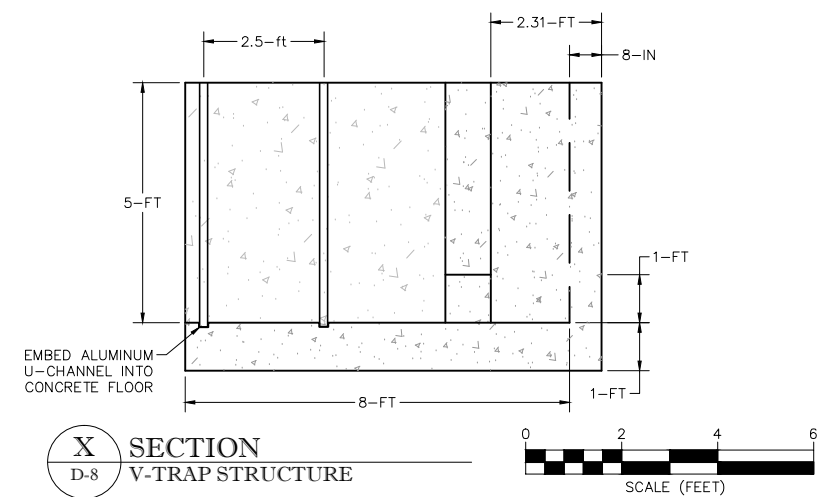
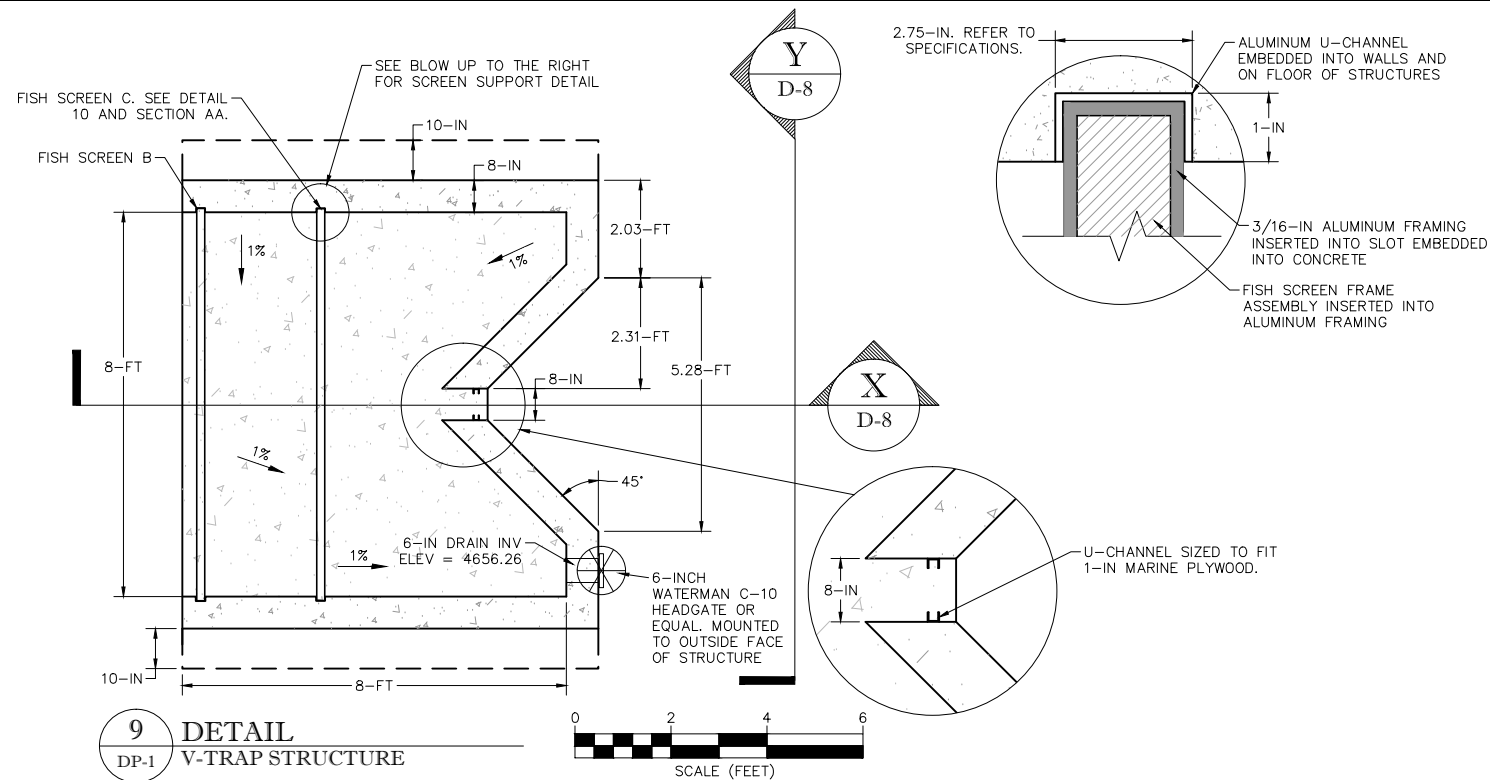
SHEET  
D-6

CHADBOURNE  
DETAILS FISH TRAP

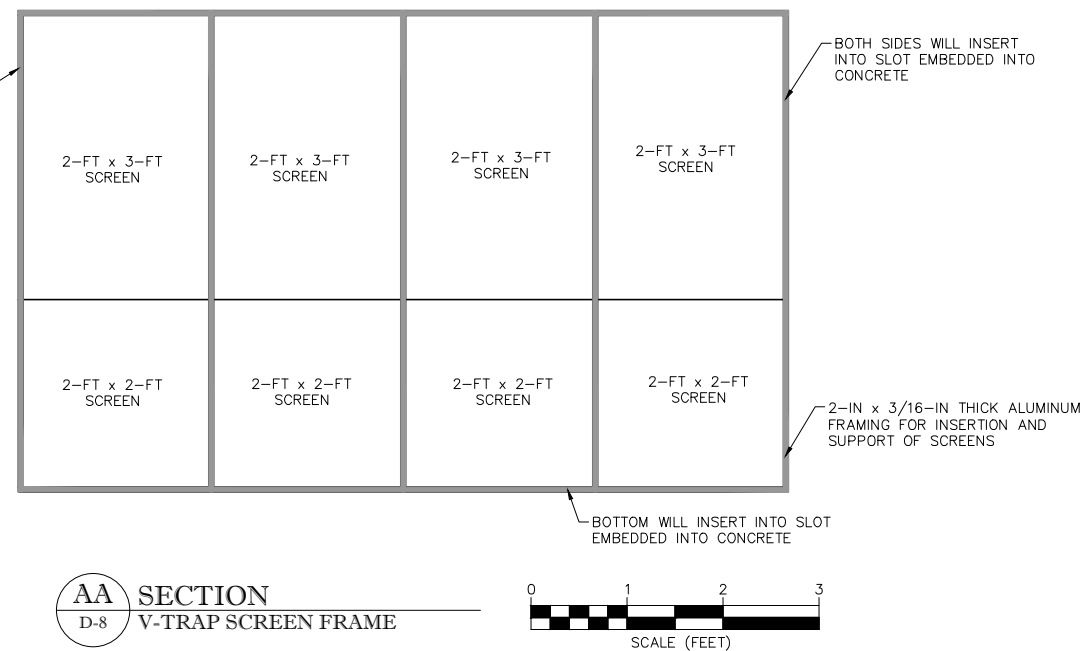
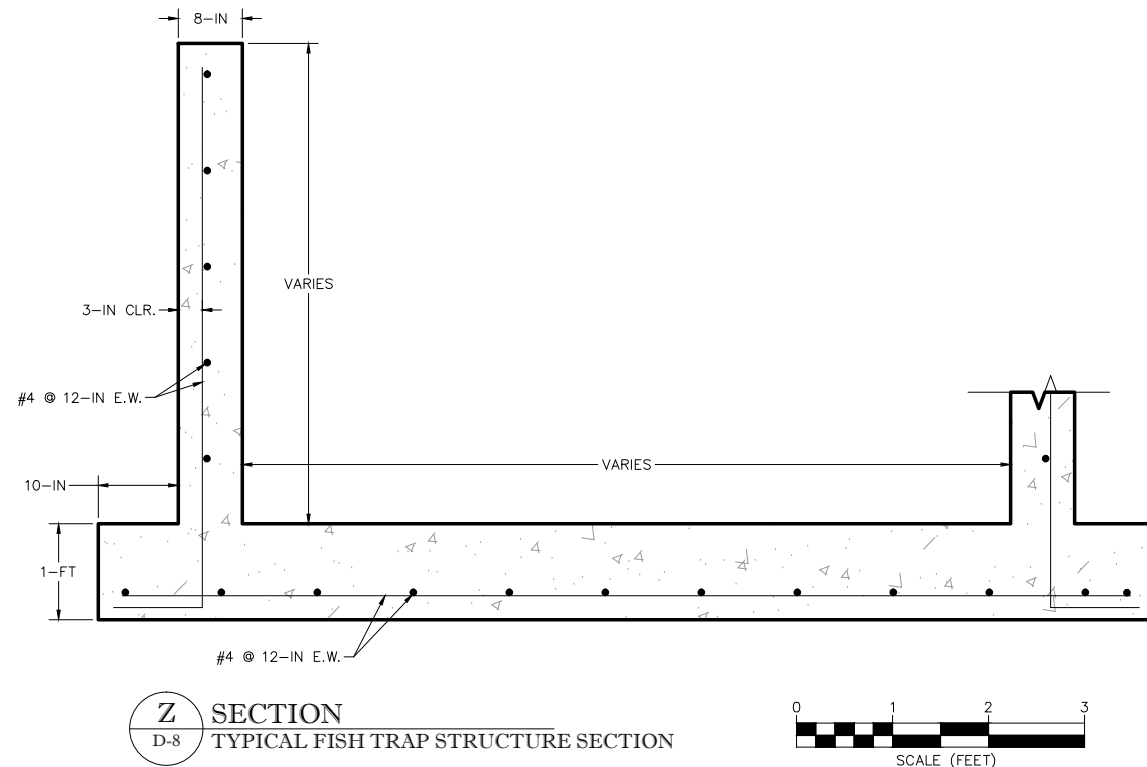
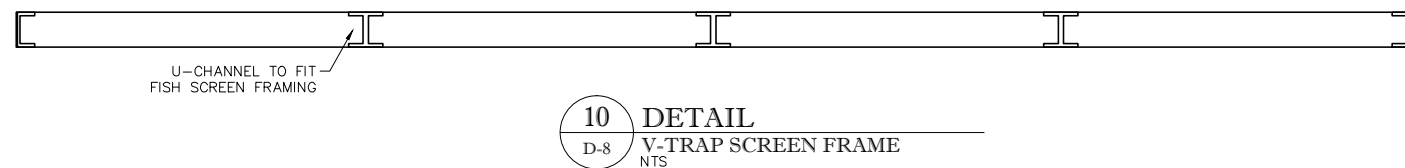
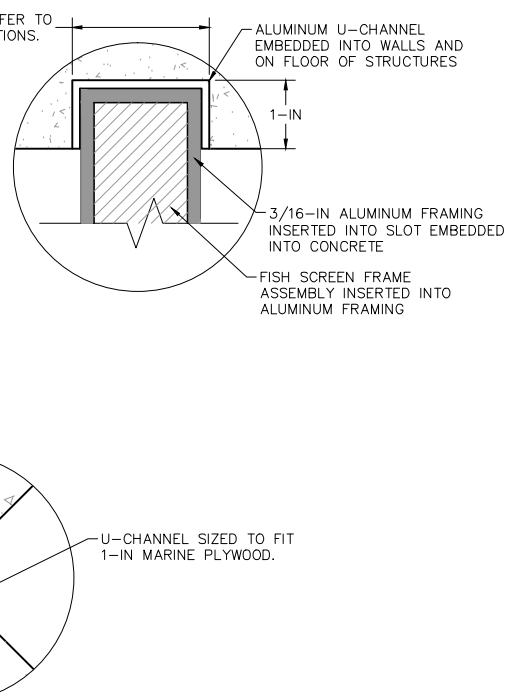
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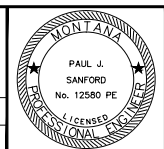


- NOTES:
- ALL FISH TRAP STRUCTURES COVERED WITH CHAIN LINK. V-TRAP IS ALSO COVERED WITH POLYETHYLENE MESH. SEE DETAIL 11 ON SHEET D-9. REFER TO SPECIFICATIONS SECTION 02400 FISH TRAP STRUCTURE.
  - SEE SECTION W ON SHEET D-7 AND SECTION P ON SHEET D-6 FOR FINISH GROUND DETAILS.



NO.	REVISIONS	DRAWN BY	DATE

PROJECT ENGINEER: PJS	DRAWN BY: RSR
DESIGNED BY: PJS, RSR	REVIEWED BY: PJS



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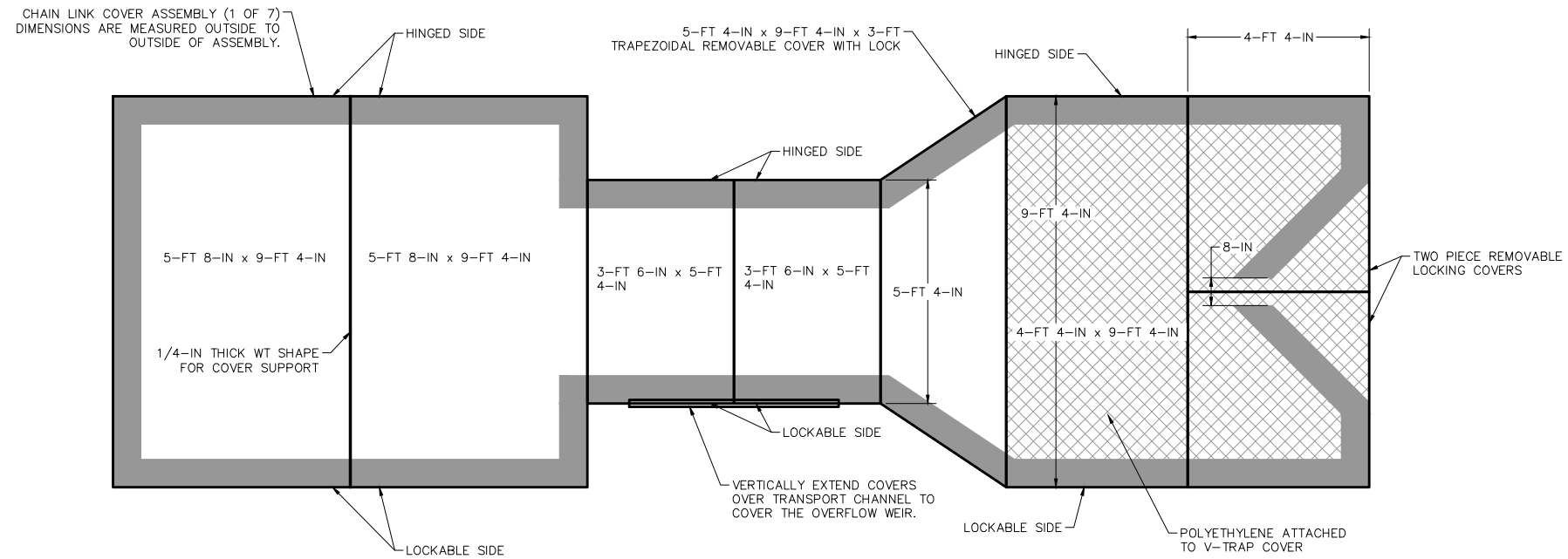


PROJECT #10-146.20
DATE: 06/27/2012
CHADBOURNE DETAILS FISH TRAP

SHEET D-8
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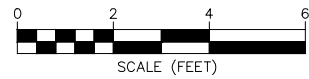




11  
D-7

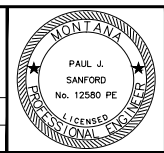
DETAIL  
FISH TRAP STRUCTURE CHAIN LINK COVERS

NOTE: REFER TO SPECIFICATION 02400 FISH TRAP  
STRUCTURE FOR SPECIFICATION OF THE CHAIN LINK COVERS.



NO.	REVISIONS	DRAWN BY	DATE

PROJECT ENGINEER: PJS	DRAWN BY: RSR
DESIGNED BY: PJS, RSR	REVIEWED BY: PJS



SHIELDS RIVER - CHADBOURNE DIVERSION RETROFIT  
DETAILS - FISH TRAP & CHANNEL  
PARK COUNTY, MONTANA

**Site Remediation**  
**Water Resources**  
**Ecological Sciences**  
**EHS Management**

#1 NINTH STREET ISLAND DRIVE  
LIVINGSTON, MT 59047  
PHONE (406) 222-7600  
www.oasisenviro.com

**oasis**  
ENVIRONMENTAL

**Civil Engineering**  
**Geotechnical Engineering**  
**Land Surveying**  
**Water Resources**

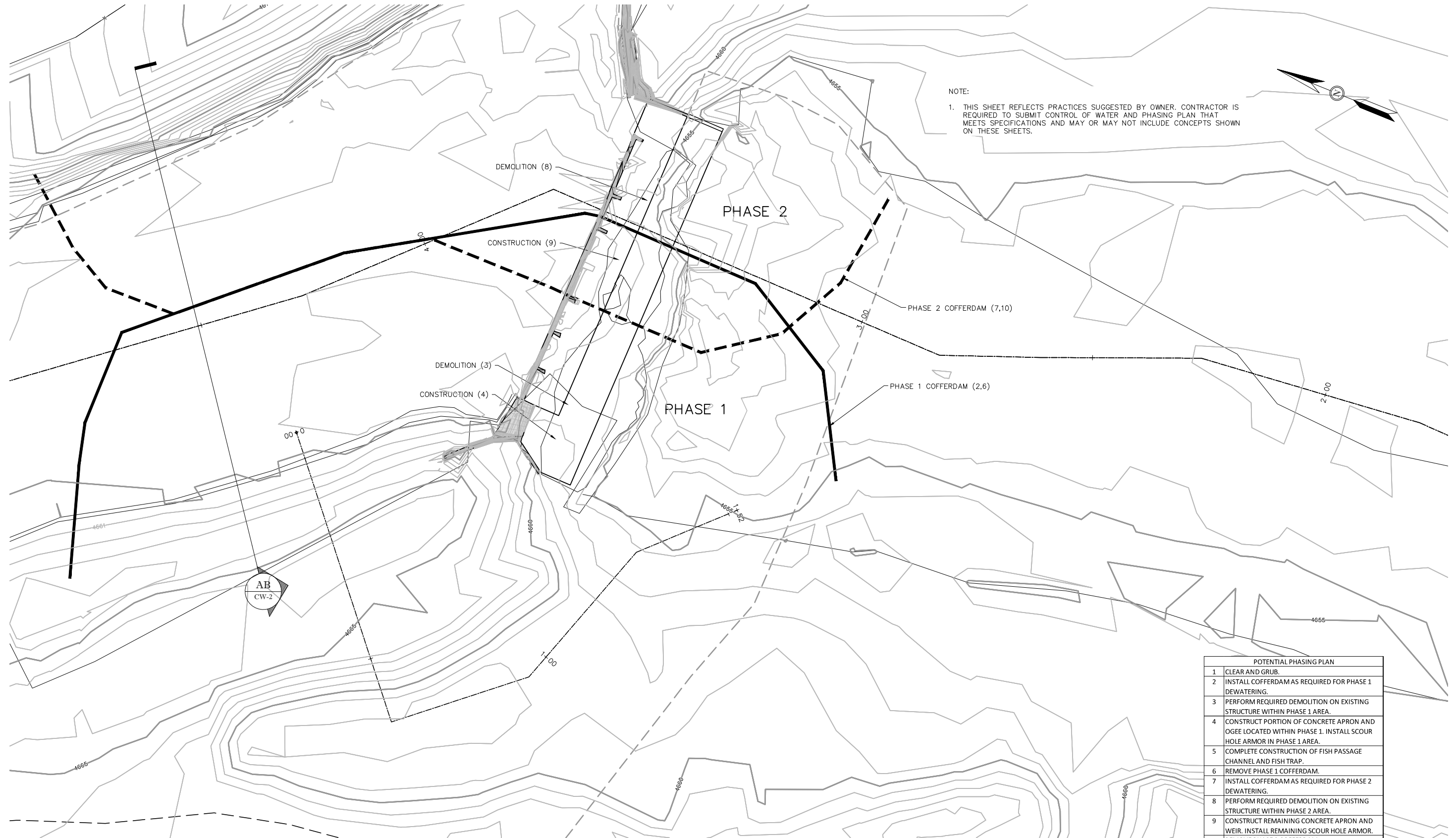
32 DISCOVERY DRIVE  
BOZEMAN, MT 59718  
PHONE (406) 582-0221  
FAX (406) 582-5770  
www.alliedengineering.com

PROJECT #10-146.20  
DATE: 06/27/2012

CHADBOURNE  
DETAILS FISH TRAP

SHEET  
D-9

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NOTE:  
1. THIS SHEET REFLECTS PRACTICES SUGGESTED BY OWNER. CONTRACTOR IS REQUIRED TO SUBMIT CONTROL OF WATER AND PHASING PLAN THAT MEETS SPECIFICATIONS AND MAY OR MAY NOT INCLUDE CONCEPTS SHOWN ON THESE SHEETS.

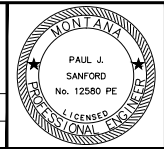
POTENTIAL PHASING PLAN	
1	CLEAR AND GRUB.
2	INSTALL COFFERDAM AS REQUIRED FOR PHASE 1 DEWATERING.
3	PERFORM REQUIRED DEMOLITION ON EXISTING STRUCTURE WITHIN PHASE 1 AREA.
4	CONSTRUCT PORTION OF CONCRETE APRON AND OGEE LOCATED WITHIN PHASE 1. INSTALL SCOUR HOLE ARMOR IN PHASE 1 AREA.
5	COMPLETE CONSTRUCTION OF FISH PASSAGE CHANNEL AND FISH TRAP.
6	REMOVE PHASE 1 COFFERDAM.
7	INSTALL COFFERDAM AS REQUIRED FOR PHASE 2 DEWATERING.
8	PERFORM REQUIRED DEMOLITION ON EXISTING STRUCTURE WITHIN PHASE 2 AREA.
9	CONSTRUCT REMAINING CONCRETE APRON AND WEIR. INSTALL REMAINING SCOUR HOLE ARMOR.
10	REMOVE PHASE 2 COFFERDAM.

NO.	REVISIONS	DRAWN BY	DATE

0102030  
SCALE (FEET)

PROJECT ENGINEER: PJS  
DESIGNED BY: PJS, RSR

DRAWN BY: RSR  
REVIEWED BY: PJS



SHIELDS RIVER - CHADBOURNE DIVERSION RETROFIT  
CONTROL OF WATER OVERVIEW  
PARK COUNTY, MONTANA

Site Remediation  
Water Resources  
Ecological Sciences  
EHS Management

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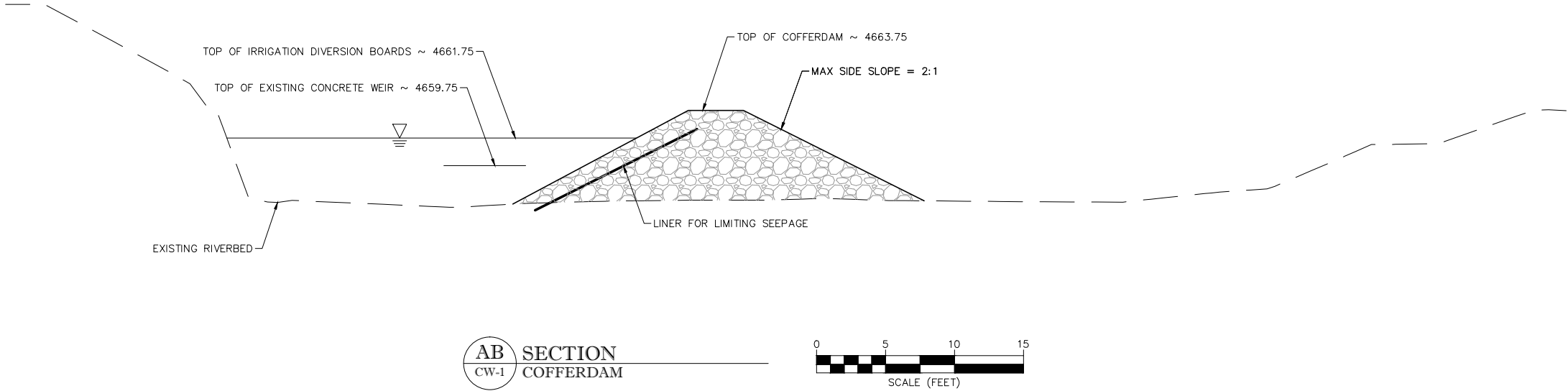
PROJECT #10-146.20  
DATE: 06/27/2012

CHADBOURNE  
CONTROL OF WATER

SHEET  
CW-1

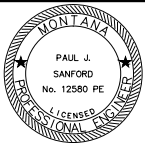
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1. THIS SHEET REFLECTS PRACTICES SUGGESTED BY OWNER. CONTRACTOR IS REQUIRED TO SUBMIT CONTROL OF WATER AND PHASING PLAN THAT MEETS SPECIFICATIONS AND MAY OR MAY NOT INCLUDE CONCEPTS SHOWN ON THESE SHEETS.



NO.	REVISIONS	DRAWN BY	DATE

PROJECT ENGINEER: PJS  
DESIGNED BY: PJS, RSR  
DRAWN BY: RSR  
REVIEWED BY: PJS



SHIELDS RIVER - CHADBOURNE DIVERSION RETROFIT  
DETAILS FOR CONTROL OF WATER  
PARK COUNTY, MONTANA

Site Remediation  
Water Resources  
Ecological Sciences  
EHS Management

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PROJECT #10-146.20  
DATE: 06/27/2012

SHEET  
CW-2

CHADBOURNE  
CONTROL OF WATER